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# REPORT

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FINAL REPORT

Commander's CBR-D Decision

Training Aid (DECAID)

Demonstration Model and

Design Refinement

To

U.S. Naval Training Systems Center

12350 Research Parkway

Orlando, Florida 32826

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JULY, 1989

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July 11, 1989

Rhonwyn Carson, Ph.D.  
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Dear Rhonwyn:

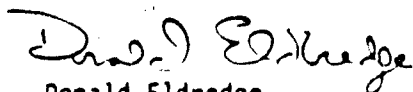
FINAL REPORT  
 CONTRACT NO. DLA900-86-C-2045, TASK 77  
 COMMANDER'S CBR-D DECISION AID  
 (DECAID) DEMO MODEL AND DESIGN REFINEMENT

Enclosed are three (3) copies of the final report, "Commander's CBR-D Tactical Decision Aid (DECAID) Demonstration Model and Design Refinement." The final report has been revised to include all government comments and recommendations, per our conversation of 6-29-89.

I am still collecting data and pursuing answers to the other hardware/software questions that we raised in our previous conversation, and I will provide you with additional information and material as soon as it is available.

Should you have any questions concerning the final report, please call me at (614) 424-7054 or Louis Tijerina at (614) 424-5406.

Sincerely,



Donald Eldredge  
 Projects Manager

DE:dd

Enclosures (3)

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## REPORT DOCUMENTATION PAGE

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on

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(DECAID) DEMONSTRATION MODEL AND DESIGN REFINEMENT

to

U.S. NAVAL TRAINING SYSTEMS CENTER



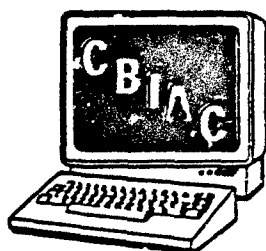
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by

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## EXECUTIVE SUMMARY

### Problem

Chemical, Biological, and Radiological Defense (CBR-D) training has been identified by the fleet as deficient insofar as it has been dealt with as an independent topic, not closely interrelated with the overall shipboard mission which may be taking place in the CBR environment. The CBR-D area is unique in that the defensive measures (i.e. closing up the ship and outfitting the crew in protective clothing) cause nearly as much mission degradation as would an attack itself. Shipboard Damage Control Assistants need sophisticated training to be able to effectively weigh the risks associated with employing CBR defense measures, and to make appropriate choices consistent with ship mission. Effective risk management training is made especially difficult due to the fact that no experienced mentors are available who have experienced Naval operations in a CBR-D environment. The Damage Control Assistant course of instruction currently teaches established CBR-D doctrine and procedures in a classroom setting, but does not provide operational experience in the area of CBR-D risk management, or integrate CBR-D decisions into the overall tactical picture.

### Objective

The objective of this effort is to prepare a design specification which could be used to design a prototype training device/decision aid (DECAID) that would provide scenario based training in shipboard CBR-D decision making. This would be in the form of a desk-top trainer which could be utilized as part of the curriculum for the Damage Control Assistant course of instruction conducted at the Surface Warfare Officer School, Newport, Rhode Island.



## Approach

The overall approach of DECAID technology development has been to describe a computer terminal simulation of the displays, inputs, and information resources that would be available in Damage Control Central aboard ship. By means of scenario-driven situations, the DCA would be called upon to make decisions both of a simple, procedural nature as well as the more complex decisions that require risk analysis to determine costs and benefits of the various possible decision options. This training device would integrate CBR-D considerations with other topics taught in the Damage Control Assistant course of instruction, including firefighting and flooding, and provide hands-on exposure to the impact of the damage control effort on the overall ship mission.

This document reflects the results of a 6.2 research effort that has attempted to expand the technology base in the area of training officers to make better decisions in an area where the fleet has negligible operational experience, and where there is therefore no coherent body of "right" or "wrong" solutions. It is not itself the design for a CBR-D decision trainer; rather, it provides the detailed criteria from which a design could be developed and against which any operational or prototype training device might be evaluated.

## Conclusions

Development of a CBR-D decision aid/training device (DECAID) is feasible through an application of existing technologies. With only minor hardware upgrades and off-the-shelf software, it can be installed on a standard desktop computer. It can be included as a part of the DCA course of instruction with no increase in instructor manning.

Providing scenario-based CBR-D training as a part of the DCA curriculum, utilizing DECAID technology, will correct a longstanding deficiency in CBR-D training. It represents a quantum conceptual jump in training delivery systems for Damage Control, and would enhance the capability

of the fleet to effectively operate in a CBR-D environment, should that situation ever occur.

DECAID technology can be used as the basis for training in other areas of damage control decision making, and might be adapted for use as a test bed for evaluating user interface concepts in a future automated Damage Control Management System (DCMS).

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## SECTION 1.0

### INTRODUCTION

#### 1.1 BACKGROUND

Research has shown that human performance in conditions of Chemical, Biological, and Radiological Warfare Defense (CBR-D) is often degraded to the point that the tactical situation may be severely compromised. Critical shipboard tasks often take longer than normal to complete. It may not be possible to perform some tactical operations at all. The accuracy with which crew members perform certain jobs can suffer. Novel work-arounds or manning may be required. It is, of course, possible to survive and prevail in the CBR-D environment. However, survival and victory will depend heavily on naval personnel acquiring the knowledge, skills, and procedures needed to do their jobs under conditions of CBR defense. Training, therefore, is a key element in developing the Navy's CBR-D readiness.

Decision making in the CBR-D environment is one area where training could significantly enhance fleet effectiveness. The CBR-D arena is unique in that defensive measures (i.e., closing up the ship and outfitting the crew in protective clothing) cause nearly as much mission degradation as would an attack itself. Shipboard decision makers need training to effectively weigh the risks associated with employing CBR defense measures, to make appropriate choices consistent with ship mission, and to plan operations in a CBR-D environment with CBR-D activities integrated with other aspects of a ship's operational tasking.

Of all the officer billets aboard surface ships, the Damage Control Assistant (DCA) is especially appropriate as a focus for such decision training. Currently, the DCA is the CBR-D officer aboard surface ships. In addition, the DCA is often a junior officer in terms of age, shipboard experience, and decision making expertise. Despite these limitations, the DCA is expected to carry out assigned duties with confidence and skill. In both CBR-D and conventional damage control situations, the DCA must decide on the most effective use of crew, time, and equipment resources in order to "fix" the ship and protect the crew. The extent to which the DCA serves as an effective decision maker can impact the lives of fellow crew members and the

safeguard of millions of dollars of Navy materiel. Decision training can help.

In response to the need for improved decision-making under CBR-D conditions, the Naval Training Systems Center (NTSC) has directed a series of projects to explore decision training systems for CBR defense. The first such project (DECAID I) explored concepts of use for a desktop computer training system entitled the Commander's CBR-D Tactical Decision Aid (DECAID). Tijerina, Stabb, Eldredge, Herschler, Mangold, Myers, and Treaster (1988), in their final report, describe three broad concepts of use for such a system: (1) instructional delivery, (2) scenario presentation, and (3) decision aiding. Instructional delivery would focus on presentation of facts and procedures required for CBR-D and other topics of damage control in a computer-based training format. Scenario presentation would provide decision making opportunities and offer the student DCA a chance to see plausible consequences associated with how certain risk management decisions were made. Finally, decision aiding would provide models and databases useful in managing human, time, and equipment resources under conditions of CBR-D. Tijerina, et al. (1988) provide a description of these concepts of use as well as a description of functional attributes a suitable hardware/software system might have to support DECAID as a desktop PC-based system.

A second project (DECAID II) attempted to identify models and databases which might prove useful as decision aids for DECAID. These models and databases covered topics such as heat stress predictors, task time increment, spread of airborne contaminants through a ship ventilation system, and human reliability. The project surveyed the state of the art in appropriate CBR-D models and databases which might be used for decision support aboard ship, as well as drive simulations, scenarios, or wargames realistically when a CBR-D overlay was imposed. The results of this second DECAID project are presented in Ramirez, Rayle, Tijerina, and Treaster (1988).

This report describes the results of DECAID III. Prior to the development of DECAID, a demonstration model of the system was deemed necessary to provide illustrations of the various concepts of use. This would, in some sense, "bring to life" the concepts which had been presented primarily by words in the first project report. Once a DECAID demonstration



model was constructed, it would offer fleet representatives with something tangible to react to. It was felt that this would be the best way to solicit fleet input on the most appropriate DECAID concept of use.

## 1.2 OBJECTIVES

The objectives for this project (DECAID III) were:

- To develop a storyboard demonstration which illustrated various DECAID concepts of use
- Present the storyboard demonstration to selected fleet representatives and solicit their input on what concepts would be most beneficial to the fleet, and
- Prepare a detailed design specification for DECAID which refined the focus for the applications indicated by the fleet representatives.

## 1.3 PROJECT TASKS

There was three main project tasks:

Task 1: Develop a DECAID Demonstration Model,

Task 2: Present the DECAID Demonstration Model to selected Navy representatives, and

Task 3: Prepare a Preliminary Detailed Design Specification.

Each of these tasks will be described below.

### 1.3.1 Task 1: Developing the DECAID Demonstration Model

The DECAID Demonstration Model (hereafter called the DECAID demo) required Battelle to purchase appropriate software and hardware under this contract. The Surface Warfare Officer School (SWOS), Newport, RI, had strongly suggested that DECAID be configured to run on a Zenith Z-248 PC, since it is the Navy's standard desktop computer. With the understanding that a high-performance version of the Z-248 might be required for DECAID but was still in keeping with this directive, Battelle purchased the following equipment for this project:

- A Zenith Z-286 (commercial equivalent of a Z-248) system with one 1.2 megabyte 5-1/4" disk drive, a 20 megabyte Winchester drive, 512K of RAM, and MS-DOS;

- A Zenith 14" diagonal CRT flat technology color monitor with 640 x 480 pixel resolution and 31 kHz scan rate capability; and
- A Microsoft 2-button Mouse.

The following software was also purchased to develop the DECAID demo:

- Skylights/GX, a rapid prototyping software package which will run on IBM PC machines and compatibles like the Z-248s, and
- DeluxePaint II, a graphics package used to develop ship plates, icons, and other images included in the DECAID Demo.

With this system, the first months of the project were spent developing DECAID demo examples, screens, and interface concepts.

Specifically, the DECAID demo had the following components:

- A computer-based mockup of Damage Control Central (DCC), complete with Damage Control Plates for an FFG 7 class frigate, clinometer, firemain pressure gauges, and intercoms to repair parties, the bridge, and the Chief Engineer. Also included were a variety of interface concepts developed specifically for the demo;
- An illustration of scenario presentation elements, using pre-defined sequence of screens;
- An instructional delivery sequence, RAD CALC, which provided computer-based instruction on radiation plots and calculations; and
- Demonstration of a variety of decision aiding concepts presented through a DECAID feature called the "Master Chief". The decision aiding concepts included database retrieval from NWP 62-1 and NSTM CH. 470, automated routing, and heat stress prediction for various MOPP levels.

Printed examples of the screens which were part of the DECAID demo are provided in Tijerina, Stabb, Treaster, and Mayton (1988). As part of this project, NTSC will be provided with the software for the DECAID demo.

#### 1.3.2 Task 2: Present the DECAID Demonstration Model to selected Navy Representatives

After the DECAID demo was prepared, it was presented to the following Navy representatives:

- Naval Training Systems Center
- Surface Warfare Officer School Damage Control Staff

- 1988 OPNAV/NAVSEA Damage Control Working Group Meeting.

For the DC working group meeting, a slide presentation of DECAID was prepared to facilitate presentation in a conference format; the DECAID demo was also set up to provide actual hands-on demonstrations.

The initial target audience for DECAID is the Surface Warfare Officer School, Newport, RI, because it is the sole training site for the Damage Control Assistant course of instruction. (Note: DCA training is conducted in various places, especially aboard ship during REFTRA and with computer-based on-board training (OBT). SWOS, however, has the only formalized course of instruction (COI) for DCAs.) Therefore, specific comments provided by the SWOS damage control staff will be presented in Section 3.0 of this report. However, the DECAID demo was favorably received by other fleet representatives as well. For example, the RAD CALC portion of the demo was seen as having the potential to fill a fleet training requirement for radiation calculation identified at the 1988 CNET Damage Control and Firefighting Training Standardization conference. Furthermore, DECAID interface concepts aroused the interest of representatives from the NAVSEA Damage Control Management System (DCMS) program office for possible application to DCMS. In general, the DECAID demo fulfilled its purpose as a "point for discussion" to solicit fleet inputs.

### 1.3.3 Task 3: Prepare a Preliminary Detailed Design Specification

The intent of the DECAID I was to generate concepts of use for a CBR-D decision training system for Navy personnel. It would then be up to the Navy to decide on which concepts of use should be implemented and the order in which they should be pursued. To help the Navy draw those conclusions, the project reported here (DECAID III) put together an interactive demonstration of how these concepts might look (the DECAID demo) so that fleet representatives might better evaluate them.

Review of the DECAID demo has enabled SWOS representatives to make informed recommendations as to which concepts of use will be of greatest value to the fleet. Based on those inputs (described in Section 3.0), a preliminary

detailed design specification has been prepared which forms the bulk of this report. The nature of the detailed design specification is described below.

In addition to various concepts of use, DECAID I produced a general functional description of a desktop computer system to support instructional delivery, scenario presentation, and decision aiding. The DECAID demo developed under the current contract allowed SWOS representatives to evaluate these concepts, from which they have selected scenario presentation as the most urgent near-term application of DECAID technology to the DCA course of instruction. The detailed design specification contained in this report, then, focuses on scenario presentation and expands the previous functional design to include the details necessary to design and build the system. The DECAID preliminary detailed design specification is included in Section 4.0 of this report.

Some general comments on the detailed design specification are in order. The detailed design specification is intended to provide an expanded description which details the functionality of DECAID in order to support future system development. Nothing in the detailed design specification should be taken as "cast in concrete". A subsequent design effort is required to interpret the specifications contained herein into detailed coding algorithms, screen designs, and user input procedures using a selected language, target hardware configuration, etc. Thus, the detailed design specification is a guideline for system development and implementation. During the creative process of design, however, elements within the specification, as stated, may need to be revised or changed to take advantage of programming opportunities and constraints imposed by the software language and the target hardware. As the design process unfolds, for instance, enhanced implementation approaches may arise which replace implementation concepts suggested here.

As part of the subsequent 6.3 effort, a core set of scenarios will be designed, in which many contingencies will be programmed. It is anticipated that these contingencies will often be judgement calls from one or more subject matter experts. For example, one contingency rule may be "two more crew members to a fire party means fire can be brought under control 10% faster". During R&D developmental activities, a prototype will allow Navy

personnel to determine the adequacy of these initial estimates for contingencies and constraints; if they are perceived as unrealistic, they can be changed as needed. In addition, the feasibility of using models and databases identified in DECAID II will also be considered at that time for generating realistic contingencies and consequences. In summary, the enclosed detailed design specification is intended to be reviewed, evaluated, and changed as needed to meet the implementation goals. The Detailed Design Specification itself is a product of conversations with subject matter experts, the application of current computer science knowledge and expertise, and the utilization of sound user-computer and human factors expertise with respect to the design of a scenario presentation system.

## SECTION 2.0

NAVY INPUTS TO DECAID SYSTEM DEVELOPMENT

SWOS review of the DECAID demo and subsequent discussions with Battelle personnel led to a number of important conclusions and recommendations. Table 2-1 summarizes SWOS conclusions and recommendations on the DECAID system concept as a whole. Table 2-2 provides specific suggestions on DECAID functional capability. In essence, DECAID as a scenario presentation system was judged to be the most useful near-term concept of use for the SWOS DCA course. The focus of DECAID scenarios should be to present realistic shipboard damage control scenes demanding risk management decisions, i.e., decisions which do not have explicit right or wrong answers. DECAID should provide feedback on decisions made during a scenario event in the form of plausible contingencies and consequences of those decisions which are reflected in later scenario events. In addition, feedback may be presented in the form of "Did you consider...?" narrative provided in scenario debriefing screens, or perhaps as HELP screens. Scenarios should not treat CBR-D in isolation but rather provide multiple damage control tasks (e.g., flooding and CBR-D decontamination together, firefighting and firemain management together) to support greater realism and afford the student DCA a chance to appreciate the unity of damage control. Also, DECAID should be a stand-alone system which will not require heavy instructor involvement while students are interacting with the scenarios.

In addition to the general recommendations provided in Table 1, SWOS Damage Control staff were asked to review inventories of DCA duties and tasks. Specifically, they were to indicate those duties and tasks which they believed involved high-order decision making and judgement rather than standard operating procedure (SOP) or automatic responses which could be learned by rote. They were also asked to rank the selected duties and tasks in terms of whether they are considered by SWOS to be of primary or secondary importance for possible inclusion in DECAID computer-based scenarios. The intent of this review was to compile a "wish-list" of potential decision tasks which DECAID training scenarios might exercise. This does not imply that DECAID must present scenarios in which all DCA duties and tasks are exercised. However,

TABLE 2-1

## SUMMARY OF SWOS RECOMMENDATIONS ON DECAID SYSTEM DEVELOPMENT

- 1) SWOS supported the further development of DECAID technology.
- 2) The SWOS DCA course provides the student with extensive information on shipboard damage control duties and tasks. However, there is little time for the student to integrate these facts and principles, to practice making decisions in a shipboard damage control/CBR-D context, and to experience plausible consequences of those decisions.
- 3) Accordingly, DECAID as a scenario presentation system was judged to be the most beneficial concept of use for the DCA course of instruction.
- 4) The intent of DECAID scenario presentation should be to provide the student an interactive decision opportunity environment which incorporates near real-time feedback on the impact of the damage control decision on the ship as a complete system.
- 5) DECAID scenarios can provide the student DCAs with feedback in two ways. First, scenarios should provide feedback in the form of plausible contingencies and consequences of current decisions which effect succeeding events in a scenario. In addition, SWOS finds it desirable to have feedback in the form of "Did you consider ...?" narrative, presented to the student, which is outside the context of events in the scenario, perhaps as part of debriefing conducted at the end of a scenario.
- 6) DECAID scenarios should emphasize risk management and pose decision tasks which do not have clear right or wrong answers. Instead, the feedback should detail potential effects on the ship and crew as a system. Also, the DCA student can see the results of decisions as they occur in the scenario.
- 7) SWOS emphasized that the DECAID trainer will be of minimal value if its scope is limited to CBR defense applications in isolation of other aspects of shipboard damage control. DECAID should strive to foster the integration of the disciplines of fire-fighting, stability, power, ventilation, CBR-D, and management of available resources in the context of the tactical shipboard environment.
- 8) DECAID should have the ability to automatically record and statistically compare student DCA decisions to selected damage control problems to support the evolution of the DCA Curriculum and for student evaluation.

TABLE 2-1. (Continued)

- 9) SWOS wants DECAID to operate as a stand-alone system. (This, in essence, is a personal tutor concept--the instructor sets up problem and then goes away.) The Damage Control staff did not embrace a concept of use which involves significant instructor participation while students are working at the system.
- 10) SWOS would like to see DECAID provide decision opportunities throughout the DCA course. Initially, only a single casualty type (e.g., firefighting, CBR-D, stability) might be included in a scenario based on what the student has learned to date. As students progress, however, more variation and multiplicity of casualties would be introduced into a single scenario.
- 11) With regard to length of a scenario, SWOS believes a 15-minute scenario "slice" is feasible. Basically, this would mimic perhaps two-hours worth of decisions made aboard ship but with the dead-time of shipboard response cut out. (Another way to think of this is that the on-going events would run in "fast" time while the DCA's decision-making would be in real time.)



TABLE 2-2

## SWOS RECOMMENDATIONS ON DECAID FUNCTIONALITY

- 1) Allow view of 2 or 3 decks vertically (exploded view).
- 2) Have compartment names and numbers on all compartments, else have a locator function that accepts a compartment name or number as input and displays as output the appropriate section of the ship plates (with some compartments named and numbered).
- 3) When the firemain breaks and the DCA isolates it, DECAID could provide information like what plugs are disabled, what vitals (like water to a magazine) have been affected, etc.
- 4) Include watertight doors/compartments in list of compartments to be passed through in decon routing.
- 5) Have fallout graphics depict what would happen if the water washdown system were turned on.
- 6) Be careful not to program unlikely or skewed contingencies into the system, lest students be misled to think such contingencies are typical.
- 7) Eventually, DECAID could offer different scenarios for different ship types, so that a student going to a carrier, for instance, could work with carrier scenarios.
- 8) A zoom function for the computerized ship plates would be good to see firemain plug numbers and compartment names and numbers.
- 9) Time limits could be built into scenarios; if an action takes too long, problems get worse and worse.
- 10) It may be desirable to have a "help" function at difficult decision points so the student can jump out of the scenario, get help, and then jump back in. (This might require a Pause function.)
- 11) Have easily updated software to change the training system when new shipboard systems are implemented.
- 12) In a scenario, do not automatically display the ship's damaged area. Instead, require the student to find the right section of the ship plates (as they must do now aboard ship).
- 13) Good decision aiding in DECAID is offered by the graphic representation of the decks and compartments with overlays and compartment information.

those which are considered of high priority should be considered first in scenario design.

Three SWOS staff members in each of the areas of firefighting, stability and buoyancy, and CBR defense completed reviews of a task inventory prepared for their content areas. References used to compile the DCA Task Inventory included Naval Warfare Publication 62-1A (1985), the CBR-D Handbook for Training (1985), Naval Ship's Technical Manual Chapter 470 (1985), McWhirter, Stickles, Toomey, Finger, Keith, Willis, North and Purcell (1986), and the Job Task Inventory for the Damage Control Assistant used by SWOS. From the responses of SWOS DC staff, a finalized task listing was prepared in the following manner: A task was retained for the finalized list if at least two out of three reviewers agreed the task involved decision making and judgement more than SOP or automatic responses. In addition, a rating of "High", "Medium", and "Low" priority for possible inclusion in DECAID scenarios was derived through analysis of the combined priorities assigned to selected tasks by the reviewers. The results of the SWOS evaluation for duties and tasks in the areas of Chemical/biological warfare defense, radiological warfare defense, firefighting, and flooding are included as Table 2-3, Table 2-4, Table 2-5, and Table 2-6 respectively. Finally, Table 2-7 presents generic damage control decision making tasks which do not fit neatly within any one damage control discipline but rather encompass coordination across functional areas.

TABLE 2-3

**DCA DUTIES AND TASKS FOR POSSIBLE INCLUSION IN DECAID SCENARIOS:  
CHEMICAL/BIOLOGICAL WARFARE DEFENSE DUTIES AND TASKS**

(Note: Duties and tasks without a priority rating indicates they were not selected by a majority of SWOS subject matter experts. They are included here for completeness, and may be used as incidental tasks in DECAID scenarios).

Priority

**A. Operating in Vicinity of Possible BW/CW Threat**

- |        |  |
|--------|--|
| Medium | 1. Recommend Condition Zebra for all doors leading to weather decks and on ventilation system fittings   |
|        | 2. Conduct operational inspection of personnel decontamination stations  |
|        | 3. Breakout and issue M-258/258A1 personnel decontamination kits   |
|        | 4. Inspect chemical and biological sampling kits to ensure completeness  |
|        | 5. Conduct operational inspection of washdown system   |
|        | 6. Post M-8/9 detector paper throughout ship   |
| High   | 7. Recommend MOPP level to CO, taking into account the time period during which operations will have to be sustained and environmental heat stress factors; consider MOPP level modified for certain spaces, e.g., mask only for engineering spaces. |
| Medium | 8. Determine whether weather conditions are favorable for an attack  |
|        | 9. Coordinate antidote injectors with medical supply.  |

**B. BW/CW Attack Probable**

- |        |   |
|--------|---|
| High   | 1. Recommend Circle William (Called out in CBR bill and adhered to during REFTRA. However, real world situations may involve judgement calls on when to set Circle William, e.g., while operating for two weeks in an area where attack is probable for the duration of the stay and it is infeasible to set Circle William for the entire time). |
| Medium | 2. Recommend intermittent activation of washdown system (See item 1.)   |
| High   | 3. Activate selected personnel decontamination stations (involves decision to man decon stations, take manpower away from other operations)   |
| Low    | 4. Dress out internal traffic controller ('Dress out' interpreted to mean donning MOPP gear, hence a judgement to be balanced off with considerations of heat stress, encumbrance of MOPP gear and its impact on critical shipboard operations, etc.)   |
| Medium | 5. Dress out and equip all essential topside personnel (See item 4)   |
|        | 6. Direct repair lockers to stand by to transmit internal chemical sampling data to DCC, and biological samples to Medical Department   |

TABLE 2-3. (Continued)

- |        |     |  |
|--------|-----|--|
| High   | 7.  | Recommend MOPP level to CO (including areas of the ship where MOPP may be relaxed) |
| Low    | 8.  | Establish watch station rotation   |
| Medium | 9.  | Establish CBR-D equipment usage  |
| Medium | 10. | Determine heat stress factors and risk   |
| Medium | 11. | Respond to requests for routes   |

## C. BW/CW Attack Imminent

- |        |    |  |
|--------|----|--|
| Medium | 1. | Recommend Circle William                           |
| Medium | 2. | Recommend continuous activation of washdown system |
| High   | 3. | Recommend MOPP level to CO                         |
| Medium | 4. | Estimate CBR-D equipment usage                     |
| Medium | 5. | Respond to requests for routes                     |

## D. BW/CW Attack Occurs

- |        |    |   |
|--------|----|---|
| Medium | 1. | Order repair lockers to conduct internal sampling survey using M-256 chemical detector kits and biological kits |
| High   | 2. | Determine extent of contamination (Involves collating damage reports, asking for verification)                  |
| High   | 3. | Advise bridge of current and predicted B/C hazards based on available information and estimate time of removal  |
| Low    | 4. | Establish routes for casualties   |
| Medium | 5. | Establish routes for decontamination teams  |
|        | 6. | Investigate for structural damage   |

## E. Operational Recovery Phase

- |        |    |   |
|--------|----|---|
| Low    | 1. | Recommend continuous activation of washdown system for 15 minutes   |
| High   | 2. | Order repair lockers to conduct detailed sampling of external areas using M-256 chemical detector kits and biological sampling kits (in the event of other damage, DCA must decide about manpower requirements) |
|        | 3. | Continue internal survey until there is no longer an indication of internal contamination (Tied to readiness posture; if another attack possible, keep survey going, as spelled out in CBR bill)                |
|        | 4. | When external decontamination has been completed, retest and report to predesignated area   |
|        | 5. | Announce location of casualty collection station  |
| Medium | 6. | Inform bridge when ship is clear of all known contamination (related to #3 above)   |
|        | 7. | Inventory Individual Protective Equipment (IPE), detector paper, etc. to determine extent of shortages  |
|        | 8. | Determine actions/recommendation if all areas cannot be thoroughly decontaminated   |

TABLE 2-4

**DCA DUTIES AND TASKS FOR POSSIBLE INCLUSION IN DECAID SCENARIOS:  
NUCLEAR WARFARE DUTIES AND TASKS**

(Note: Duties and tasks without a priority rating indicates they were not selected by a majority of SWOS subject matter experts. They are included here for completeness and may be used as incidental tasks in DECAID scenarios).

Priority**A. Nuclear Attack Probable**

- |        |    |   |
|--------|----|---|
| High   | 1. | Order warm up and test of radiacs                           |
|        | 2. | Breakout and issue dosimeters and DT-60S                    |
|        | 3. | Recommend intermittent activation of washdown system        |
|        | 4. | Recommend Circle William                                    |
| High   | 5. | Recommend Individual Protective Equipment (IPE) level to CO |
| Medium | 6. | Evaluate weather conditions                                 |
|        | 7. | Respond to routing requests                                 |
|        | 8. | Position area monitoring dosimeters                         |
|        | 9. | Set MPE and casualty dose                                   |

**B. Nuclear Attack Imminent**

- |        |    |  |
|--------|----|--|
| High   | 1. | Recommend continuous activation of washdown system               |
| High   | 2. | Recommend Circle William   |
| Medium | 3. | Designate personnel decon and casualty collection stations       |
| Medium | 4. | Recommend that nonessential personnel take deep or ready shelter |
| High   | 5. | Recommend IPE level for topside personnel                        |
| Medium | 6. | Respond to routing requests                                      |

**C. Nuclear Attack Occurs**

- |        |     |   |
|--------|-----|---|
| Medium | 1.  | Investigate for structural damage (repair locker activity, may require DCA coordination) and evaluate impact on ship, estimate time to repair |
|        | 2.  | Assign designated personnel to deep shelter   |
|        | 3.  | Dress out all essential topside personnel   |
|        | 4.  | Predict/approximate topside and below-deck radiation intensities  |
| High   | 5.  | Commence on-station radiological monitoring   |
| High   | 6.  | Advise bridge of fallout arrival, peak intensity, and cessation   |
| High   | 7.  | Keep bridge informed of dose/rotation times for bridge personnel  |
|        | 8.  | Recommend rotation of personnel   |
|        | 9.  | Initiate rapid internal survey  |
| Low    | 10. | Initiate rapid external survey  |
|        | 11. | Recommend that countermeasure washdown system be secured  |

TABLE 2-4. (Continued)

|        |   |
|--------|---|
| High   | 12. Calculate safe stay times for external survey and decon teams   |
| High   | 13. Recommend selective decon of vital stations or general decon (judgement based on manpower availability)   |
| High   | 14. Oversee detailed survey and decontamination (determine where to post radiacs, priorities on what to decon, in what order, etc.) and maintain contamination plot |
|        | 15. Cordon off hot spots that cannot be cleared of radiation (decide what can be cleared and what can not)  |
| Medium | 16. Establish routes for casualties and replacement personnel   |
|        | 17. Activate personnel decon station  |
|        | 18. Designate casualty collection station (must decide where to place collection stations)  |
| Medium | 19. Re-designate decon/collection stations if necessary (decide when it is necessary to designate new collection stations)  |
| High   | 20. Identify mission impact of radiological contamination   |
| Medium | 21. Prioritize radiological contamination relative to other casualties  |
| Medium | 22. Determine potential spread dynamics and potential mission impact  |
| Medium | 23. Postulate potential and alternate COAs  |

TABLE 2-5

**DCA DUTIES AND TASKS FOR POSSIBLE INCLUSION IN DECAID SCENARIOS:  
FIREFIGHTING DUTIES AND TASKS**

(Note: Duties and tasks without a priority rating indicates they were not selected by a majority of SWOS subject matter experts. They are included here for completeness and may be used as incidental tasks in DECAID scenarios).

Priority

**A. Prevention of Fire or Smoke**

1. Direct the stowage, protection and elimination of combustibles
2. Inspect ship spares
3. Educate shipboard personnel in fire prevention
4. Enforce shipboard fire protection policies

**B. Detection and Identification of Fire or Smoke**

- |      |  |
|------|--|
| High | <ol style="list-style-type: none"> <li>1. Establish ship-wide reporting system</li> <li>2. Identify location and type of fire and/or smoke--establish nature of fire (DCA must evaluate reports received and determine what really is going on)</li> </ol> |
|------|--|

**C. Plan for Firefighting and Smoke Control**

- |        |  |
|--------|--|
| High   | <ol style="list-style-type: none"> <li>1. Alert appropriate fire party (repair party function)</li> <li>2. Determine optimal technique for fighting fire and controlling smoke (repair party function)</li> </ol>              |
| High   | <ol style="list-style-type: none"> <li>3. Determine equipment to be used (repair party function)</li> <li>4. Set fire boundaries</li> </ol>  |
| Low    | <ol style="list-style-type: none"> <li>5. Plan alignment of firemain</li> </ol>  |
| High   | <ol style="list-style-type: none"> <li>6. Request approvals for shutdown of electrical equipment</li> </ol>  |
| Medium | <ol style="list-style-type: none"> <li>7. Call for General Quarters (CO does this but DCA recommends GQ after weighing need vice, e.g., cost of people running to GQ stations and impeding efforts of fire parties)</li> </ol> |

**D. Plan for Personnel and Material Protection and Casualty Control**

- |        |  |
|--------|--|
| High   | <ol style="list-style-type: none"> <li>1. Determine potential combustibles within fire boundaries and plans for removal or protection (DCA gets involved in "Big Picture" of location of combustibles, magazines, etc., in order to alert repair locker leader of potential combustibles)</li> </ol> |
| High   | <ol style="list-style-type: none"> <li>2. Determine isolation procedures for personnel, material and equipment</li> </ol>  |
| High   | <ol style="list-style-type: none"> <li>3. Determine "closures" and ventilation</li> </ol>  |
| Medium | <ol style="list-style-type: none"> <li>4. Prepare evacuation plans</li> </ol>  |
| Low    | <ol style="list-style-type: none"> <li>5. Alert medical/first aid personnel</li> </ol>   |

TABLE 2-5. (Continued)

## E. Direct Firefighting and Smoke Control Activities

- |        |   |
|--------|---|
|        | 1. Inform seniors in chain of command of firefighting and smoke control status  |
| Medium | 2. Specify plan of attack to fire party leader  |
| High   | 3. Specify fire boundaries, evacuation plan, closure, ventilation control, and protection of personnel, materials, and equipment to fire party leader |
|        | 4. Maintain communications with fire party leader   |
|        | 5. Receive reports on fire and smoke status from fire party leader  |
| High   | 6. Coordinate with other repair parties ("big picture" decision type)   |
| High   | 7. Secure ventilation   |
| High   | 8. Secure electrical power  |
| High   | 9. Locate available firefighting resources  |
| High   | 10. Identify potential hazards  |
| High   | 11. Identify de-energization impacts  |
| High   | 12. Identify mission impact of fire casualty  |
| High   | 13. Prioritize fire casualty in relation to other casualties  |
| High   | 14. Determine potential spread dynamics of fire casualty  |
| High   | 15. Determine potential effects of firefighting water on ship stability   |
| High   | 16. Postulate potential and alternate COAs  |

## F. Investigation and Assessment of Fire and Smoke Damage

- |      |  |
|------|--|
|      | 1. Direct examination, examine areas within and adjacent to fire boundaries  |
| High | 2. Determine damage and casualties and effect on ship capabilities   |
| Low  | 3. Direct assessment or repair needs   |
|      | 4. Inform seniors in chain of command of results of investigation and assessment   |
|      | 5. Prepare reports   |
|      | 6. Identify oxygen and explosive tests to be conducted (repair party function)   |
|      | 7. Identify hazards/vapors (repair party function)   |
|      | 8. Identify desmoking resources (repair party function)  |
|      | 9. Identify electrical circuits to be tested (repair party function)   |
|      | 10. Identify ventilation equipments to be tested (repair party function)   |
| High | 11. Determine electrical power restore/isolate requirements (Can involve DCA judgement of priorities on what power to restore/isolate) |



TABLE 2-5. (Continued)

## 6. Direct Cleanup Activities

- |      |  |
|------|--|
|      | 1. Direct dewatering and desmoking   |
|      | 2. Direct removal of debris  |
| High | 3. Prioritize clean-up activities  |
| High | 4. Evaluate impact of dewatering, jettison of debris, etc. on ship list and trim                           |
| High | 5. Determine number of air changes through ventilation system needed to clear air of toxic gases and smoke |

TABLE 2-6

**DCA DUTIES AND TASKS FOR POSSIBLE INCLUSION IN DECAID SCENARIOS:  
STABILITY AND BUOYANCY DUTIES AND TASKS**

(Note: Duties and tasks without a priority rating indicates they were not selected by a majority of SWOS subject matter experts. They are included here for completeness and may be used as incidental tasks in DECAID scenarios).

**Priority**

**A. Detect Flooding Conditions**

1. Establish reporting system
2. Monitor gauges and instruments
3. Receive reports of impaired stability and reduction in reserve buoyancy

**B. Identify Cause of Flooding**

- |      |   |
|------|---|
| High | <ol style="list-style-type: none"> <li>1. Receive report of source of flooding (Evaluate reports with regards to accuracy and completeness)</li> <li>2. Examine received reports and determine cause and extent of damage/flooded area</li> </ol> |
|------|---|

**C. Plan for Stabilizing Ship**

- |        |  |
|--------|--|
| High   | <ol style="list-style-type: none"> <li>1. Alert repair party(ies)</li> <li>2. Call for General Quarters (CO does this; DCA recommends GQ?)</li> <li>3. Determine strategy and technique for restoring stability, and buoyancy to ship: counter flooding, ballasting/deballasting, solid weight shift, jettisoning, flooding control, plugging, patching and shoring</li> <li>4. Request command approval for ballasting, deballasting, counter flooding and jettisoning</li> </ol> |
| High   | 5. Determine equipment and material to be used   |
| Medium | <ol style="list-style-type: none"> <li>6. Determine flooding boundaries</li> <li>7. Determine need for stranding ship</li> </ol>   |

**D. Plan for Protecting Personnel, Material, Equipment and Casualties**

- |     |   |
|-----|---|
| Low | <ol style="list-style-type: none"> <li>1. Determine equipment, material and personnel safety measures (DCA judgement involved to secure electrical power to a compartment if flooding is "high enough" to warrant it, for example)</li> <li>2. Inform personnel of flooding situation, degree thereof, and safety measures</li> </ol> |
|-----|---|

TABLE 2-6. (Continued)

## E. Direct Stabilization and Buoyancy Activities

- |        |   |
|--------|---|
|        | 1. Specify plan to protect personnel, material and equipment to repair party leader (Interpreted to mean communications only of decisions made in D.I.) |
| High   | 2. Specify flood boundaries to repair party leader (Interpreted to mean both specify (i.e., figure out) and communicate)                                |
| High   | 3. Specify plans restore stability and buoyancy of ship to repair party leader(s) and other personnel   |
|        | 4. Maintain communications with repair party leader   |
|        | 5. Receive reports on stabilization and buoyancy of ship  |
| Low    | 6. Coordinate with other department/divisions in maintaining stability and buoyancy ("Big picture" resource management problem)                         |
|        | 7. Prepare list of topside material which can be jettisoned (decide on what to jettison, priority of material to be jettisoned)                         |
| Low    | 8. Direct personnel in jettison activities (decide on how to jettison)  |
| High   | 9. Secure electrical power (decide on when and what electrical systems to secure)   |
| Low    | 10. Identify hazards and de-energization impacts  |
| Medium | 11. Locate available DC resources   |
| High   | 12. Identify operational restrictions and structural weaknesses   |
| High   | 13. Determine potential flooding spread, instability, and potential mission impact  |
| High   | 14. Postulate potential and alternate COAs  |

## F. Monitor Results of Stabilization and Buoyancy Activities

- |        |  |
|--------|--|
|        | 1. Monitor, maintain, and evaluate stability status board (flooding effects diagram)                     |
|        | -- Location of flood boundaries (read the flooding effects diagram)                                      |
|        | -- Effect of list and trim   |
|        | -- Effect of corrective actions  |
|        | 2. Monitor and maintain Liquid Load Status Board (fuel and water tanks)                                  |
|        | 3. Inform supervisor, seniors, and command of ship stability, buoyancy, list, trim, watertight integrity |
|        | 4. Receive and evaluate information from all repair party leaders  |
| High   | 5. Investigate and assess flooding and causes of instability or nonbuoyancy                              |
| High   | 6. Identify hazards to equipment or personnel  |
|        | 7. Identify fume tightness   |
| Medium | 8. Determine electrical power restore/isolate requirements   |
| Medium | 9. Identify needs for system realignment/reconfiguration   |

TABLE 2-7

DCA DUTIES AND TASKS FOR POSSIBLE INCLUSION IN DECAID SCENARIOS:  
GENERIC DAMAGE CONTROL DECISION MAKING TASKS

Priority

- |        |   |
|--------|---|
| Low    | 1. Make personnel replacement recommendations, matching available, qualified personnel with manning requirements.   |
| High   | 2. Establish priority of repair/replacement for multiple damaged systems/system components, based on criticality of system, and impact on mission.                    |
| High   | 3. Identify those system components which need to be replaced and those which can be repaired with the time, personnel, material and equipment available.             |
| Medium | 4. Allocate resources (personnel, equipment, material) for the repair/replacement of system/system components across ship.  |
| Medium | 5. Determine time limits to perform restoration tasks and alternative COAs if those time limits cannot be met.  |
| Medium | 6. Determine manning requirements to perform restoration tasks and alternative COAs if the task cannot be performed with that level of manning.                       |
| High   | 7. Determine, for specific shipboard systems, acceptable/feasible degree of restoration/repair (i.e., temporary restoration vs. full functioning).                    |
| High   | 8. For containment, determine if passive boundaries (e.g., fire boundaries) are sufficient vs. whether active measures (e.g., cooling fire boundaries) are warranted. |
| High   | 9. Determine piping and ventilation system closures and circuit breakers needed to isolate damage and allow intact portions of systems to be reactivated.             |
| High   | 10. Determine appropriate alternative piping and cabling to service critical sections of the ship.  |

## SECTION 3.0

DECAID SCENARIO PRESENTATION SYSTEM: OVERVIEW

## 3.1 INTRODUCTION

The strength of the scenario form, from a training perspective, is that it presents experience rather than information. A basic assumption is that learning through direct experience can positively augment instructional delivery of facts, principles, SOPs, and doctrine. The Damage Control faculty at SWOS prefer the DECAID "scenario presentation" concepts of use for DCA training. They believe that scenario presentation is important because it would offer student DCAs an opportunity environment in which to exercise decision making skills and to bring together knowledge acquired during training. Furthermore, SWOS emphasized that scenarios in which the student plays the role of DCA will be of value only if those scenarios integrate the disciplines of firefighting, stability, power, ventilation, CBR-D, and emphasize resource/risk management of crew, time, and equipment resources. Finally, during visits to SWOS, several members of the damage control faculty suggested that an interactive format might be highly desirable. In this section, the goals of DECAID as a scenario presentation system will be discussed and an overview of the system concept intended to meet these goals will be presented. Section 4.0 of the report provides the detailed design specification relevant to the proposed DECAID scenario presentation system concept.

SWOS conclusions on the most usable concept of use for DECAID suggests that DECAID should be cast as a role-playing interactive environment which will create a "you are there" experience for the student DCA (hereafter referred to as the "user") and accomplish certain decision training objectives. The user will act in the first-person and his or her choices and actions will determine (to some extent) events which happen subsequently in the scenario. Interactions which have no subsequent effect on the scenario are termed "incidental" and can be used as filler between more demanding decision making opportunities, thus eliminating the effect of the user being confronted with crisis after crisis.

To better understand the role that the DECAID scenario presentation system would play in overall SWOS DCA training, consider the following.

Trollip and Alessi (1985) present a model of teaching which has four phases:

Phase 1: Presenting the student with information.

Phase 2: Guiding the student to develop a fuller understanding of the information presented through questions, application of rules and principles, or practice of procedural skills.

Phase 3: Practicing to enhance retention of what was taught and to develop fluency in skills.

Phase 4: Assessing learning to provide data on the level of learning achieved, the quality of teaching, future instructional needs, and instructional program modifications.

While scenarios and gaming concepts can be used in all phases of teaching, it is anticipated that the initial DECAID scenarios will emphasize the practice phase and, to a lesser extent, the assessment phase.

### 3.2 PROPERTIES OF GOOD INTERACTIVE SCENARIOS

In designing a scenario presentation system, it is useful to have design goals; those presented here seem especially appropriate. Ideally, good interactive scenarios are engaging as well as instructive and several features have been identified which make them so (Malone, 1980). Interactive scenarios have goals associated with them, stated or inferred, which the player tries to achieve (e.g., address damage control casualties with minimum time, crew, and equipment resources). They impose rules which must be followed (e.g., DCA actions must follow doctrine, there are physical constraints on the sequence in which actions may be accomplished, damage and damage control effects follow the rules of nature). Interactive scenarios contain an element of competition (e.g., one may compete against other DCA students, against oneself by improving scores, gamble against chance, etc.). Scenarios are challenging (e.g., damage control is difficult, resources are limited relative to demand). Finally, they provide a sense of safety (e.g., the student DCA can safely act out a more dangerous reality, explore alternative approaches to a problem).

If these features can be built into DECAID scenarios, then the scenarios will be more engaging than alternative scenarios without such features.

The DECAID scenarios will be situational simulations cast in a role-playing context. That is, the student will play the role of DCA in damage control situations or episodes which present different damage control challenges to which the student must respond. The elements of such simulations are provided in Table 3-1.

In order to design an initial version of DECAID, it is important to introduce various constraints. For example, the user's inputs must be constrained. Categorically, the user may answer questions, issue commands or recommendations (i.e., voice a decision), or ask for information. The user's inputs must be constrained due to the data entry technology available (e.g., keyboard and mouse) and due to limitations on the alternatives available in the scenario "script". Context should define constraints as much as possible. Constraints should follow the causal relations referenced by the scenario. Constraints are implied by the goals or objectives the user has (e.g., to minimize combat ineffective, crew, and time on casualty control).

To the extent possible, DECAID should be able to create an environment that will support choices and actions, on the part of the user, which the scenario developers could not have foreseen. This will, of course, be constrained by the degrees of freedom DECAID offers the user for articulating intents. A Yes-No choice is the most constrained interaction that may be imposed on the user; there are no surprises to the system. Similarly, a menu from which the user picks options will also offer the scenario software virtually no surprises. On the other hand, if the user were to have access to unconstrained natural language, this would offer DECAID many surprises. DECAID, in turn, might have to intrusively respond with a system message like "I DON'T UNDERSTAND YOU."

DECAID should be able to react to the user's inputs, in real time, and know what to do next in order to create a captivating scenario. DECAID, in other words, must be able to determine probable outcomes and contingencies based on current decisions and the current situation. The criteria of event appropriateness include:

TABLE 3-1

## ELEMENTS OF AN INTERACTIVE SCENARIO

**Introduction:** The initial portion of the scenario must introduce to the student:

- The objectives of the exercise (e.g., "You will play the role of the DCA aboard a FFG 7 class frigate. You will make decisions about the management of different casualties which will effect the outcome of the scenario and crew, time, and equipment resources which are expended")
- Directions on how to play the scenario
- An 'opening scene' which describes the initial situation in which the student DCA finds himself or herself.

**Body of the scenario:** The scenario itself has several components, among them:

- The realism, comprehensiveness, and emotional appeal of the scenario which determines the "you are there" experience. In keeping with this component, DECAID should be almost transparent to the user. The focus of the user's attention should be damage control aboard the USS JOHN PAUL JONES, not the keyboard of a Z-248 computer, the blanking of a screen due to a RAM overload, and so forth.
- The other players who must be simulated in the scenario (e.g., Repair II, Ship CO, Chief Engineer, etc.)
- The presence of uncertainty achieved through randomness introduced into certain processes, variable levels of difficulty, or hidden information
- The student DCA's response options:
  - Respond to requests for information
  - Request information
  - Issue commands or make recommendations
  - Receive information from crew or displays
- Information in DECAID provided by:
  - Displays and controls within DC Central
  - Messages from other crew members (e.g., bridge, Repair II, Repair III, Chief Engineer)
  - Messages from the DCA (user)
  - Messages from the Master Chief (Decision Aid)
  - System Messages which provide indications of context



TABLE 3-1. (Continued)

- Communications which make all events within an episode apparent in the scenario (casualties are introduced and tracked through communications between repair lockers and the DCA, requests for recommendations pass from the bridge to the DCA, the DCA requests status updates from the repair parties, and so on)
- The scenario conclusion with a final indication of the student DCA's 'score', feedback to each student on the progress of the scenario, and information about possible better ways to perform.

- What makes sense within the context of the particular situation,
- What fulfills the decision training objectives set for the scenario, and
- What is plausible/probable from a real-world standpoint.

These criteria provide constraints on "what should happen next".

It will probably be necessary to constrain the other simulated crew members. Constraints will come in the form of:

- What they can ask from the user
- What they can answer when questioned by the user (i.e., what they know)
- What they can do upon command/recommendation (e.g., the CO does not perform decon, the DCA does not ask repair locker leaders for permission to relax MOPP, etc.)
- What their dialogue style is like (e.g., repair locker leaders don't say "DCA, what the hell's going on down there!")
- What their traits are (e.g., navy rating, experience level, fatigue, etc.).

DECAID's primary purpose is to allow the student user to explore decision making and risk management in the context of damage control aboard navy surface ships. Therefore, the events included in the scenario should provide specific decision making opportunities. This in itself is challenging. Since there has been very little done in decision training in this application area with the approach envisioned in DECAID technology, even a modest scenario presentation system should provide respectable benefits to the user community of student DCAs.

### 3.3 OVERVIEW OF THE DECAID SCENARIO PRESENTATION SYSTEM

The DECAID Scenario Presentation System is made up of two main modules, Matrix\_Maker and the Executive (see Figure 3.1). The purpose of the Matrix\_Maker is to allow the instructor to develop a scenario by tailoring the ship status, crew status, and supply status which will be in effect when the scenario begins. The Matrix\_Maker, in other words, lets the instructor

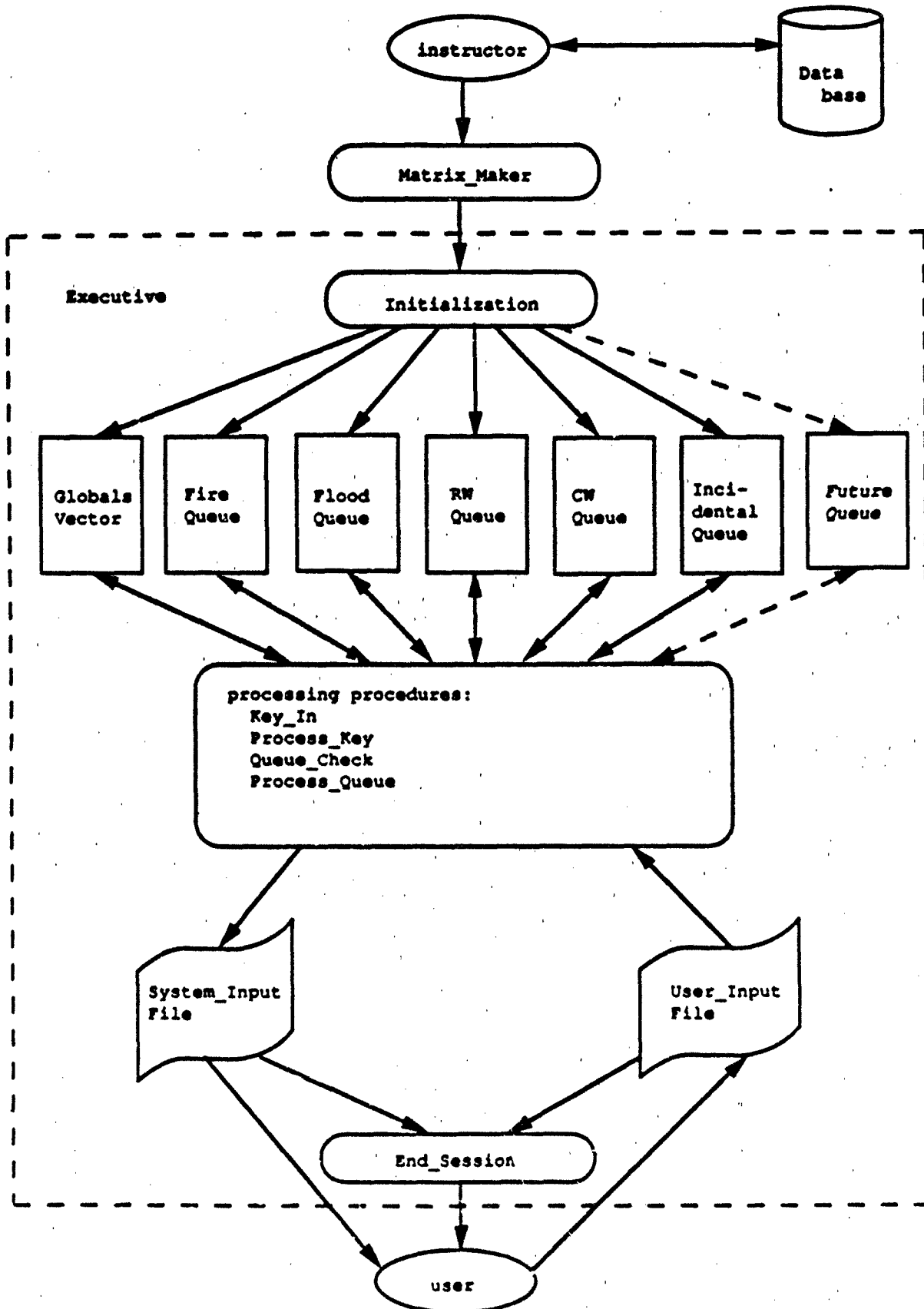


FIGURE 3.1. DECAID SCENARIO PRESENTATION SYSTEM OVERVIEW

specify the shipboard "state of the world" in which the student DCA will find himself during the scenario, i.e., the initial conditions at the beginning of the scenario. In addition, the Matrix\_Maker allows the instructor to specify the number and types of damage control challenges (casualties) to which the student must respond during the course of the scenario. Finally, incidental tasks which might be used in a scenario are also selected with this module; these are tasks, like routing, which may have no subsequent effect on the scenario but serve as secondary or "filler" tasks between more demanding decision opportunities.

In working with Matrix\_Maker, the instructor will make selections from a database of key parameters which define the shipboard state-of-the-world and casualties. Examples of background or "existing condition" parameters which might be set by the instructor include:

- Personnel status- Training level and manning level of repair lockers, key personnel out of commission, existing level of fatigue
- Logistics status- Percent on hand of gas mask canisters, M256 kits, MOPP suits, etc.
- Material status- Status of the ship, e.g., existing list and trim, fire pumps out of commission at start of scenario, major systems out of commission
- Alert status - Existing Material Condition, MOPP level, readiness condition
- Environment - Temperature, humidity, smoke and toxic gases inside of ship; wind speed, cloud coverage, precipitation outside of ship.

Examples of damage control challenges or casualties which may be presented to the student DCA include:

- Flooding - Initial location of flooding, flooding rate, cause of flood
- Fire - Class of fire, rate of spread, initial location,

- Chem agent - Type of agent, point of initial detection, rate of spread through ventilation system, location of areas of high concentration.

Thus, by configuring the resources and constraints with which the student has to work and by the mix and number of damage threats which will be presented, Matrix\_Maker offers an excellent means of tailoring scenarios to meet specific training objectives. Default values will be assigned to the various scenario parameters; these defaults may form the core set of scenarios. The defaults are then modified on an as-needed basis to accomplish the instructional goals of SWOS or other personnel to design and administer scenario-based training.

Consider next the Executive Module. The Executive is the heart of the DECAID scenario presentation system. It is responsible for calling up the prototyping or authoring system (e.g., Skylights, Quest, Windows, Hypercard) which will be needed to actually perform the simulation. The Executive is responsible for handling the presentation of screens, receipt of user inputs, determination of consequences and contingencies which affect later scenario events, and score keeping and feedback presentation to the student DCA. The Executive uses the parameters from Matrix-Maker to initialize the scenario, i.e., initializing values for global variables such as crew, materiel, and ship status at the start of the scenario. These parameters will also specify the variables as a result of the damage casualties presented during the course of the scenario, and any incidental tasks as well. Initialization within the Executive will also organize the displays that the student DCA will use, all communiques which will be presented, set all system clocks to zero, and display the initial screens. The "queues" indicated in Figure 3.1 are time-ordered processing lists which store the selected events and their relative starting times.

The Executive also contains a variety of processing procedures. For example, Key-In monitors screen and keyboard inputs from mouse and/or keypads. Process\_Key interprets these inputs from the user (collected via Key\_In) and initiates actions that these inputs require. It can, for instance, turn on a pump, ask for a different ship plate to be displayed, send a message to Repair II, and so forth as determined by the user's input. The module Queue\_Check polls the various queues mentioned above to determine what preselected event should happen next and puts that event into Active\_Queue. Another module

called Process\_Queue then releases an event in Active\_Queue and puts it into play at a time determined by a random number generator. Process\_Queue also provides for all of the changes in the global variables such as crew, materiel, and ship status, thus capturing the contingencies and consequences associated with user decisions. Process\_Queue monitors the constraint parameters to make sure that the scenario can continue or that the user has been "overtaken by events". For example, if a fire has spread more than a hundred feet due to DCA decisions (or indecision), Process\_Queue declares the ship sunk and terminates play.

User\_Input is a file generated from Key\_In and Key\_Process, i.e., it is a time-stamped listing of all user inputs to the keyboard, screen, mouse, or other input devices. System\_Input is a file generated from Initialization and Process\_Queue, i.e., it is a time-stamped listing of all system events across the scenario (queue-generated events as well as reactions to user input). End\_Session merges these two files and makes them available for presentation during replay. End\_Session would also (eventually) be the module which reads from a database of "expert opinions" about student DCA decisions and provides the student with narrative scripts tailored to those decisions. This narrative would offer points for consideration and general critiques of student behavior during the scenario rather than "right-wrong" answers.

A detailed technical discussion of the DECAID Scenario Presentation System is provided in Section 4.0 of this report.

**SECTION 4.0****DECAID DETAILED DESIGN SPECIFICATION****4.1 INTRODUCTION**

Section 4.0 of this report presents the DECAID Detailed Design Specification. The material contained in this section is intended to serve as a guideline from which all of the final details will be derived, specified and implemented, and the final system developed. The specification, contained herein, uses a mixture of textual and graphical material to present the design concepts.

**4.1.1 Organization of the DECAID Detailed Design Specification**

This and the following paragraphs provide a preview of the remaining sections of the detailed design specification as well as an overview of the overall design of the DECAID Scenario Presentation System, all from a systems architecture perspective. Sections 4.2 and 4.3 present a more in-depth look at DECAID's two major modules "Matrix\_Maker" and "Executive", and the lower level modules and routines which comprise them. The level at which these two are presented includes sufficient detail to provide a conceptual and logical view of the procedures and modules. The Functions provided by Matrix-Maker and the Executive are intended to support the development and presentation of scenarios similar to the example scenario included in Appendix 4.0 A. This example scenario reflects the types of decision tasks, contingencies, and impacts that would be part of scenarios generated using the proposed scenario presentation system.

The highly detailed section of "1.2 Fire\_Setup" (Section 4.4) is included in this design specification to show the required depth that will need to be developed and formalized in flowcharts before the material can be presented to a programmer for coding and testing. It will require a significant effort (in terms of providing the level of detail, the final design, and the specification of the data structures and data representation) to complete the design and develop these complex flowcharts.

The "Overview of Queue\_Check and Process\_Queue" (Section 4.5) is intended to give the reader a better understanding of how these two modules work together to present the scenario. An example of the pseudo-code that a programmer may generate follows. The "Decision Tree" section (Section 4.6) explains the various types of nodes and depicts a sample decision tree. Finally, a Glossary is included at the end of this report for the reader's convenience.

#### 4.1.2 Overview of System

Figure 4.1 presents the high level overview of the proposed DECAID Scenario Presentation System, its pathways and its interactions.

The instructor uses "Matrix\_Maker" to "build" the input matrix of the scenario for the student. In building this matrix, the instructor will need to access the DECAID Scenario Presentation System database (see Appendix 4.0 B). "Matrix\_Maker" will take the initialization parameters and defaults from the instructor and prepare an input file in the format that the "Executive" module is expecting. The "Executive" upon receiving the input vectors will perform Initialization. The Initialization process will put the various events onto their respective queues, and will set the global variables and system constraints vector. These queues and vector will be accessed by additional modules and processing procedures to provide continuity through the scenario, i.e., keep track of the various events (fire, flood, etc.) throughout the scenario. Both "Key\_In" and "Process\_Key" are concerned with user input while "Queue\_Check" and "Process\_Queue" are involved with processing events in their respective queues. The system input is recorded and then presented to the user. Whenever the user responds, that response is first recorded and then processed by additional modules. Both user input and system input, when they are recorded, are time tagged and placed in their respective files. Upon completion of the scenario, "End\_Session" will be activated to present the sessions actions to the user for review.



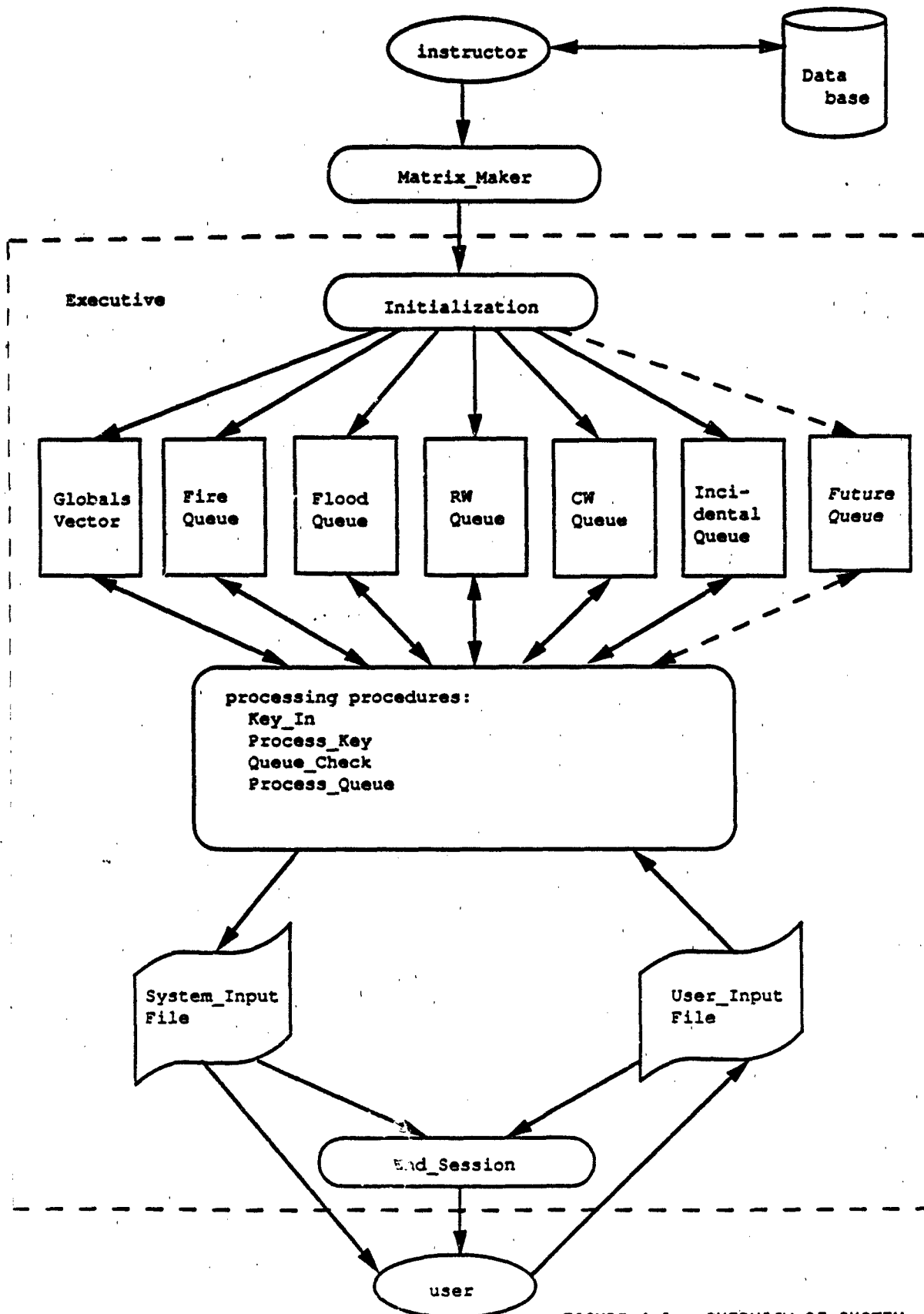


FIGURE 4.1. OVERVIEW OF SYSTEM

## 4.2 DETAILED DESIGN - "MATRIX\_MAKER"

In this section, the Detailed Design Specification for the major module "Matrix\_Maker" is developed and presented.

### 4.2.1 0.0 Matrix Maker

The "Matrix\_Maker" module, along with its routines, is the control point for the development of the Initial Conditions Matrix (ICM) which is subsequently used by the "Executive" module and its routines (see Section 4.3). The way that the Design Specification views the matrix differs from the way that it appears in the matrices given in Table 4.2 and Table 4.3. The purpose behind the two representations is that, while it is more natural for people to think of a matrix as a table, the DECAID system software will store it either as a vector or an array of records. The table format, then, is intended to be used as a worksheet by the instructor to structure the scenario parameters.

The matrix will initially contain default parameters for the scenario setup, type of event, and incidental tasks. The instructor may modify these default parameters as desired, thus tailoring the scenario to meet specific training objectives. This may be accomplished by changing data fields on a series of data entry screens. Technically speaking, the initial context of the matrix will be the six "lines" ("world", "CW", "RW", "FIRE", "FLOOD", and "INCID"), as shown in Figure 4.2, with each line containing the default parameters. The final context of the matrix will be the values of the global parameters (crew, materiel, and ship status), and the description of events to be presented to the user. This transformation will be accomplished in the system by opening the matrix and using the default parameters as a background to be altered and writing out the actual parameters starting at line seven of Figure 4.2 (see Table 4.1). After completion of the Initial Conditions Matrix, control will be passed to the "Executive" module, and the scenario presentation process may begin.

TABLE 4-1  
INITIAL CONTROL MATRIX

Index

|   |       |       |  |
|---|-------|-------|--|
| 1 | WORLD | 00:00 | <i>remaining parameters. (default).</i>                |
| 2 | CW    | 00:00 | <i>remaining parameters. (default).</i>                |
| 3 | RW    | 00:00 | <i>remaining parameters. (default).</i>                |
| 4 | FIRE  | 00:00 | <i>remaining parameters. (default).</i>                |
| 5 | FLOOD | 00:00 | <i>remaining parameters. (default).</i>                |
| 6 | INCID | 00:00 | <i>remaining parameters. (default).</i>                |
| 7 | FLOOD | 03:38 | <i>remaining parameters. as the Instructor entered</i> |
| 8 |       |       |  |
|   | .     |       |  |
|   | .     |       |  |
|   | .     |       |  |
| n |       |       |  |

↑  
Event  
type

↑  
Real-time to start

The Initial Control Matrix contains six lines of default values which correspond to the six different items that the Instructor specifies in "Matrix Maker". The Output Pointer, which points at the line that is the intended recipient of the input, initially points to line seven. It is at line seven that the "Executive" will begin reading. Note that in this example, the instructor has already entered information needed to cause a Flood during the scenario.

TABLE 4-2. INITIAL CONDITIONS MATRIX - BACKGROUND SETUP

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 |
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|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

TABLE 4-2. (Continued)

| 5.  | 6.                              |                     |                  |                | 7.              |  |  |  |
|---|---------------------------------|---------------------|------------------|----------------|-----------------|--|--|--|
|   | For Each Item at 10% Increments | 5 Degree Increments | 5 Day Increments | 5 % Increments | 10 % Increments |  |  |  |
| 5. Logistic inventory status                    |                                 |                     |                  |                |                 |  |  |  |
| Gas mask canisters                              |                                 |                     |                  |                |                 |  |  |  |
| OBA canisters                                   |                                 |                     |                  |                |                 |  |  |  |
| Sets of unopened protective clothing            |                                 |                     |                  |                |                 |  |  |  |
| Spare CO2 bottles                               |                                 |                     |                  |                |                 |  |  |  |
| Drums of spare Aqueous Film Forming Foam (AFFF) |                                 |                     |                  |                |                 |  |  |  |
| Spare Halon bottles                             |                                 |                     |                  |                |                 |  |  |  |
| Calcium Hypochlorite bottles (decon solution)   |                                 |                     |                  |                |                 |  |  |  |
| Booklets of M4 paper                            |                                 |                     |                  |                |                 |  |  |  |
| M258 kits                                       |                                 |                     |                  |                |                 |  |  |  |
| M256 kits                                       |                                 |                     |                  |                |                 |  |  |  |
| Gasoline for P-350 pumps                        |                                 |                     |                  |                |                 |  |  |  |
| (default 100%) for each element                 |                                 |                     |                  |                |                 |  |  |  |
| 6. Environmental Conditions                     |                                 |                     |                  |                |                 |  |  |  |
| Air Temperature                                 |                                 |                     |                  |                |                 |  |  |  |
| (def. 75)                                       |                                 |                     |                  |                |                 |  |  |  |
| Sea (injection) Temperature                     |                                 |                     |                  |                |                 |  |  |  |
| (def. 50)                                       |                                 |                     |                  |                |                 |  |  |  |
| Relative Humidity                               |                                 |                     |                  |                |                 |  |  |  |
| (default 75)                                    |                                 |                     |                  |                |                 |  |  |  |
| Percent Cloud Cover                             |                                 |                     |                  |                |                 |  |  |  |
| (default 50)                                    |                                 |                     |                  |                |                 |  |  |  |
| Sea State                                       |                                 |                     |                  |                |                 |  |  |  |
| (default 1)                                     |                                 |                     |                  |                |                 |  |  |  |
| Alert Status                                    |                                 |                     |                  |                |                 |  |  |  |
| Readiness Condition                             |                                 |                     |                  |                |                 |  |  |  |
| (default III)                                   |                                 |                     |                  |                |                 |  |  |  |
| Material Condition                              |                                 |                     |                  |                |                 |  |  |  |
| (def. Yoke)                                     |                                 |                     |                  |                |                 |  |  |  |
| MOPP Level                                      |                                 |                     |                  |                |                 |  |  |  |
| (default I)                                     |                                 |                     |                  |                |                 |  |  |  |
| Threat Condition                                |                                 |                     |                  |                |                 |  |  |  |
| (default none)                                  |                                 |                     |                  |                |                 |  |  |  |

TABLE 4-3  
INITIAL CONDITIONS MATRIX - CASUALTIES SETUP

| Damage Characterization - Fire                     | Damage Characterization - Flooding                   |
|--|--|
| Initial Location<br>(Six options forward, six aft) | Initial Location<br>(Four options forward, four aft) |
| Class of Fire<br>(default C)                       | Flooding Rate<br>(def. 30)                           |
| Rate of Fire Spread<br>(def. 1)                    | Cause of Flooding<br>(def. hole)                     |

[illegible]

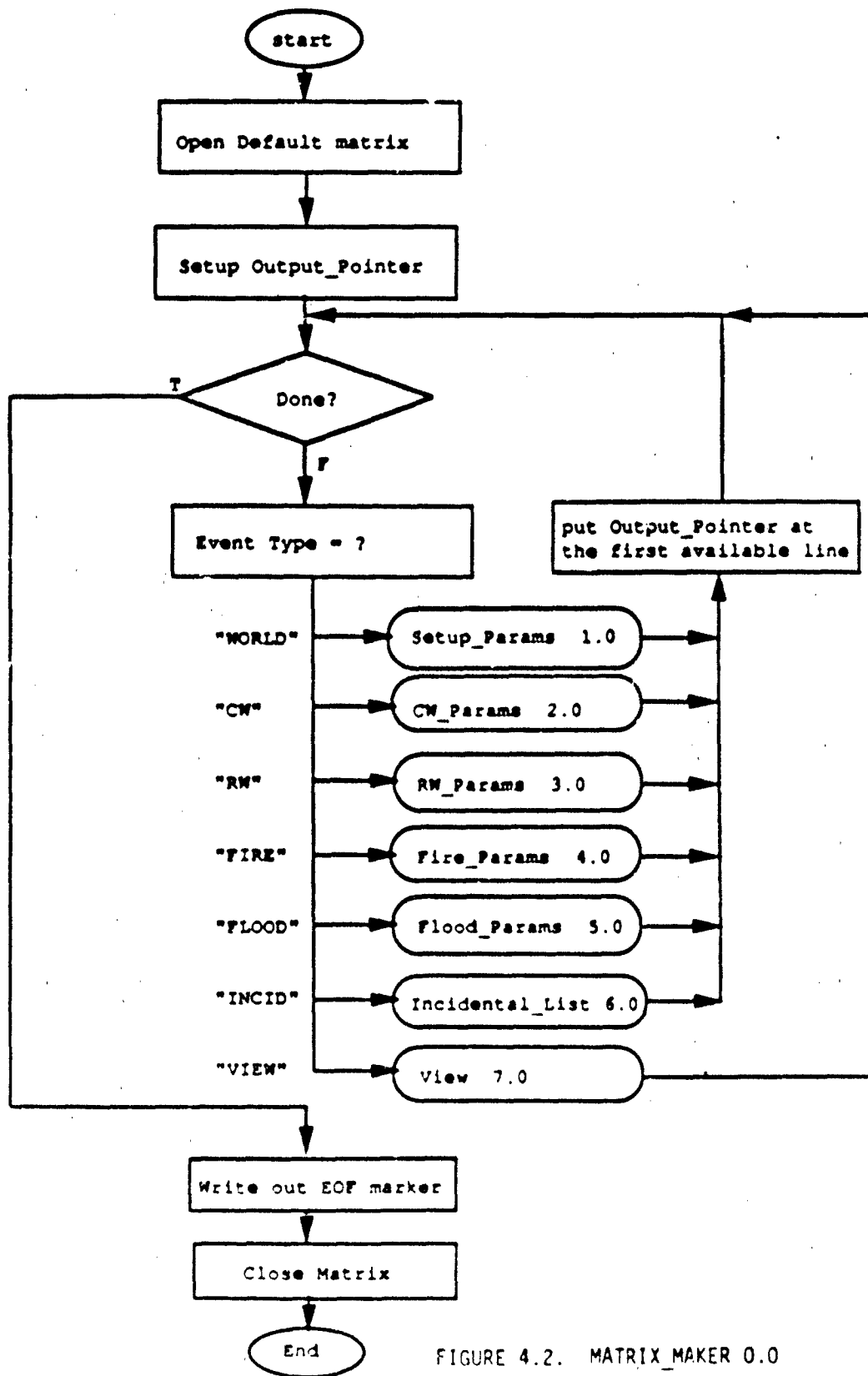


FIGURE 4.2. MATRIX\_MAKER 0.0



#### 4.2.2 1.0 Setup Params

The purpose of the "Setup\_Param" module (Reference Figure 4.3) is to enter the setup parameters into the matrix. "Setup\_Param" accepts instructor selections for various parameters or else reads default values for these parameters from the database indicated at the top right of Figure 4.1. The information from the database is displayed, and the instructor is given the opportunity to accept it as is, or tailor it to his current needs. When the Setup is accepted, it is written out to the appropriate position in the matrix.

##### 4.2.2.1 1.1 Display\_Setup

The "Display\_Setup" module (Reference Figure 4.4) provides a pre-formatted screen on which to present the current Display-Setup parameters to the instructor for update. For this version of the Design Specification, the pre-formatted screen, presented in Figure 4.4, is an approximation of what is envisaged for the final system.

#### 4.2.3 2.0 CW Params

The Module "CW\_Params" is used to enter parameters for Chemical Warfare scenario events. The values are entered into the Initial Conditions Matrix (ICM). Default values, derived from the database, already exist for these parameters. The instructor may either use the defaults or change them to create a unique scenario tailored for specific training objectives. As parameter values are changed, they replace the default values in the matrix. The instructor may also select a time range for the activation of an event in the scenario. This selected time range provides the upper and lower boundaries of possible starting times; within this boundary, a random number generator determines the exact time of event onset. This general approach is also used for RW\_Params, Fire\_Params, and Flood\_Params. Additional technical details are provided below.

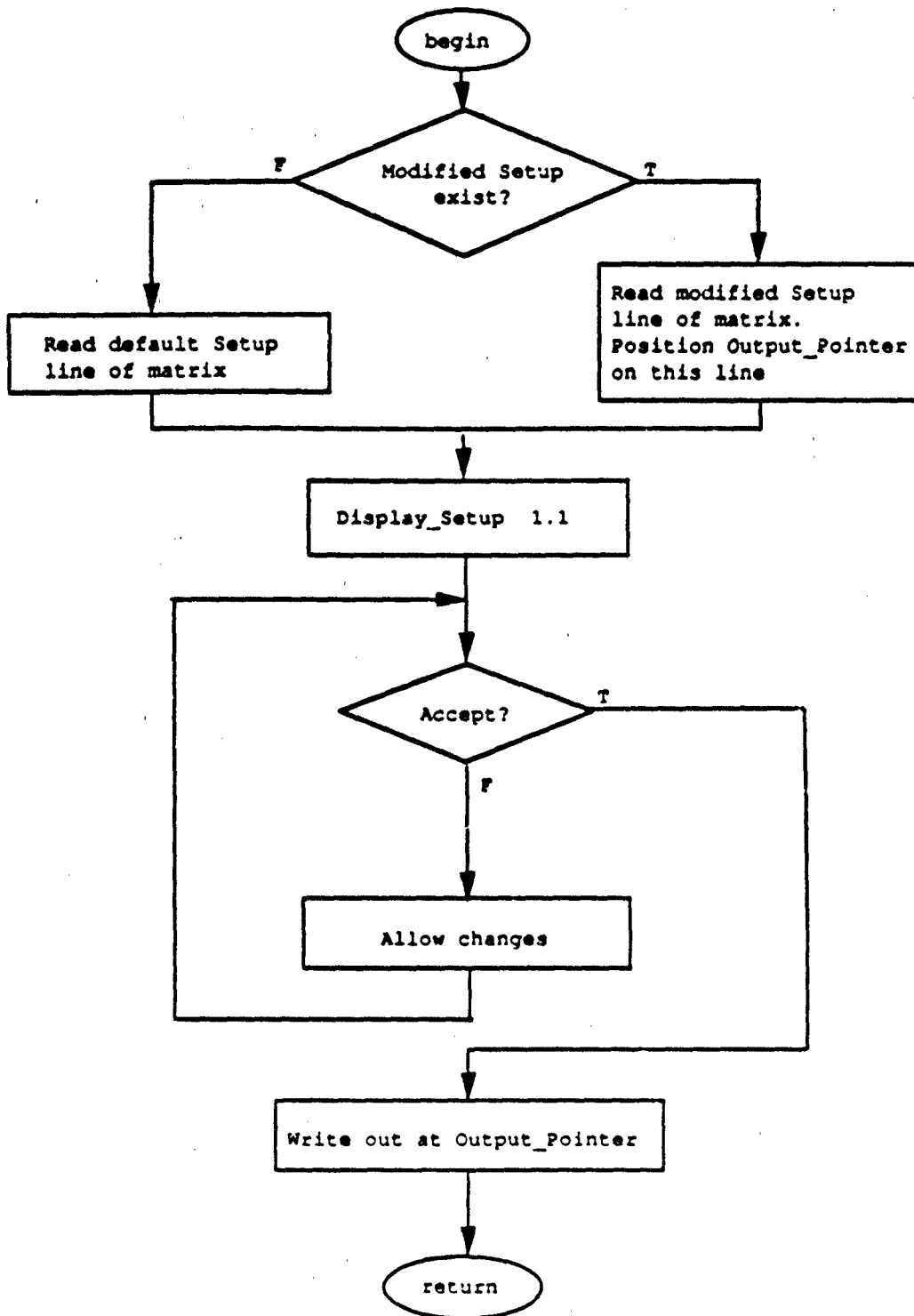


FIGURE 4.3. SETUP\_PARAMS 1.0

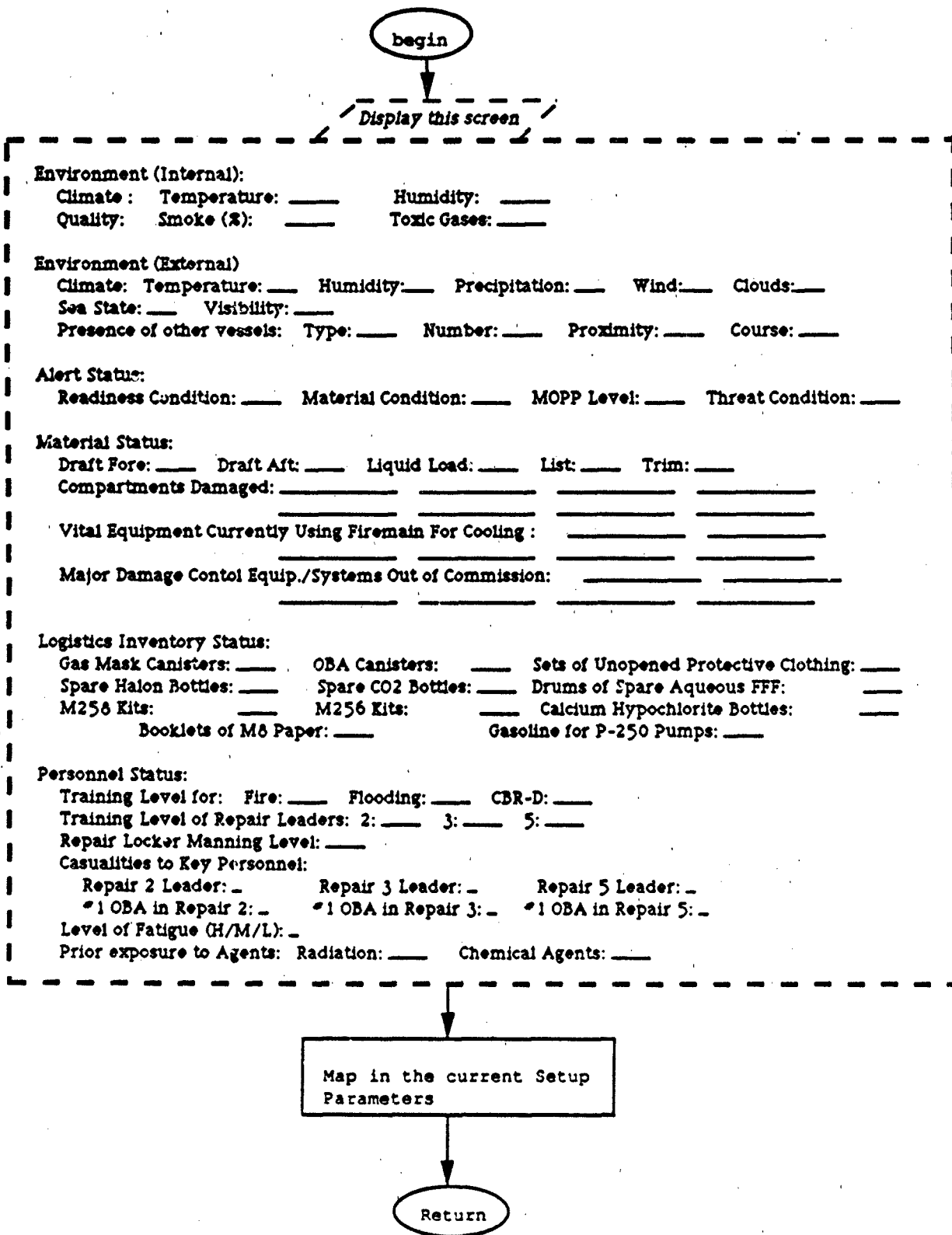


FIGURE 4.4. DISPLAY\_SETUP 1.1

As mentioned above, the purpose of the "CW\_Params" (Reference Figure 4.5) module is to enter the Chemical Warfare (CW) scenario parameters into the matrix. If any lines in the matrix below line six (Reference Figure 4.2) already exists that contain CW information, then a list of the existing CW records is presented to the instructor, as the instructor may desire to update one of the existing records or create a new CW record. According to whether one of the existing CW records is chosen or not will determine which line of CW information to read from the matrix, the previously entered CW or the default CW record. The information from the line is displayed, and the instructor is given the opportunity to accept it as is, or tailor it to his current needs. The parameter allowing the entry of the time range (real time) is used to estimate when a (CW) event should be expected to start. The time range is used as a constraint of possible times, since the exact time of onset will be determined by the random number generator. When the CW variables are accepted, they will be written out to the appropriate position in the internally stored matrix.

#### 4.2.3.1 2.1 Display\_CW

The "Display\_CW" module (Reference Figure 4.6) provides the pre-formatted screens which present the current CW parameters to the instructor for revision.

#### 4.2.4 3.0 RW Params

The purpose of the RW\_Params module (Reference Figure 4.7) is to enter the radiological warfare (RW) scenario parameters into the matrix. If any lines in the matrix below line six (Reference Figure 4.2) already exists that contain RW information, then a list of the existing RW records is presented to the instructor, as the instructor may desire to update one of the existing records or create a new RW record. According to whether one of the existing RW records is chosen or not will determine which line of RW information to read from the matrix, the previously entered RW or the default RW record. The information from the line is displayed, and the instructor is

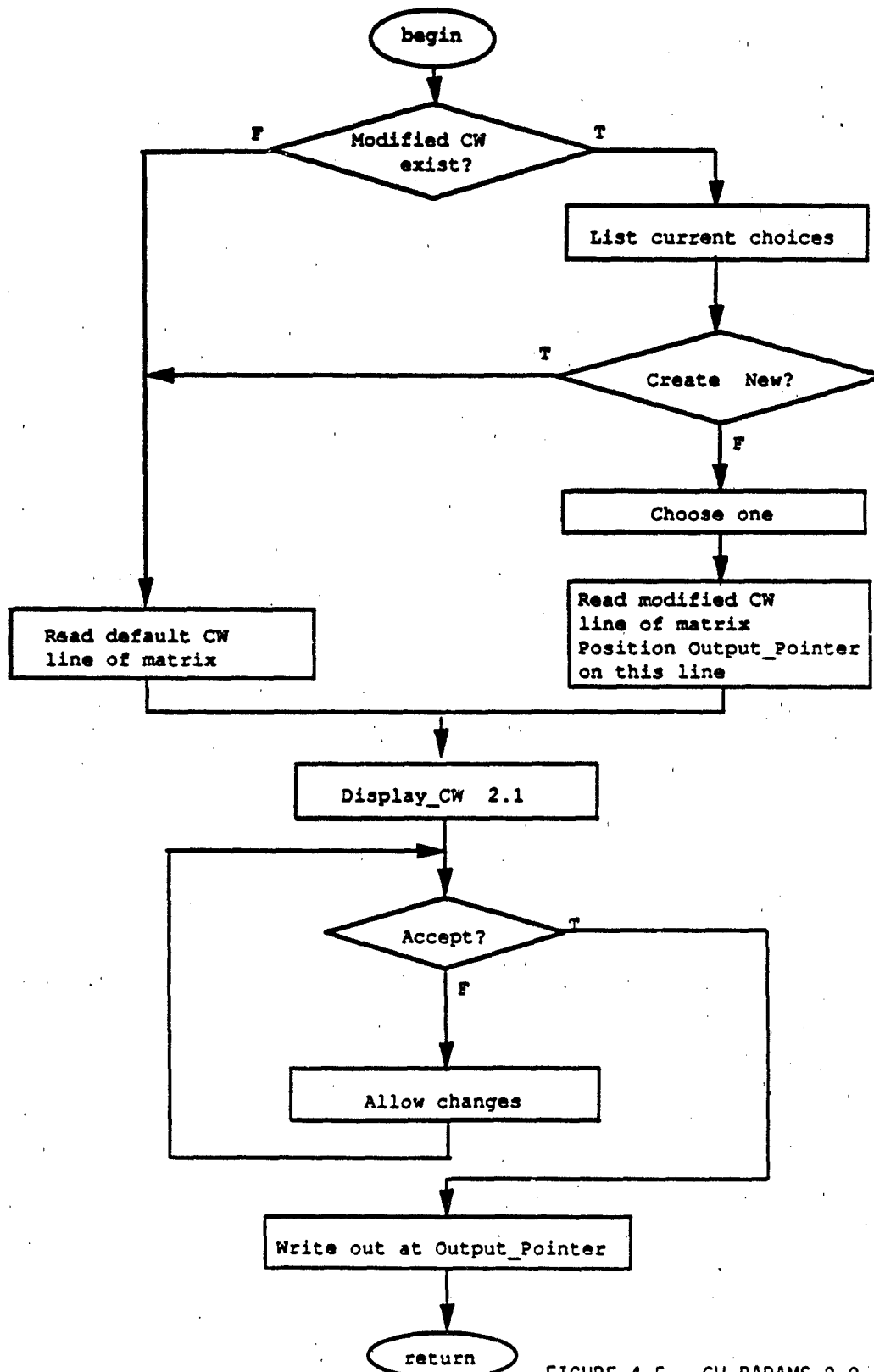


FIGURE 4.5. CW\_PARAMS 2.0

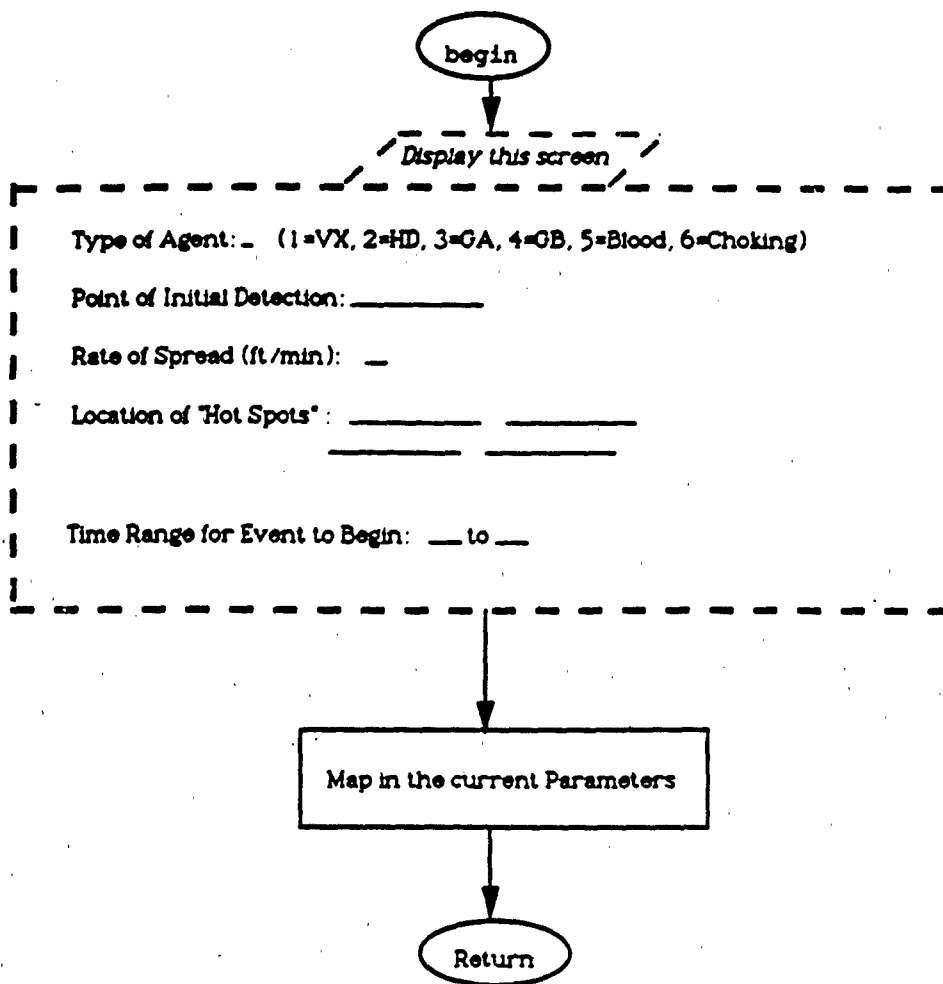


FIGURE 4.6. DISPLAY\_CW 2.1

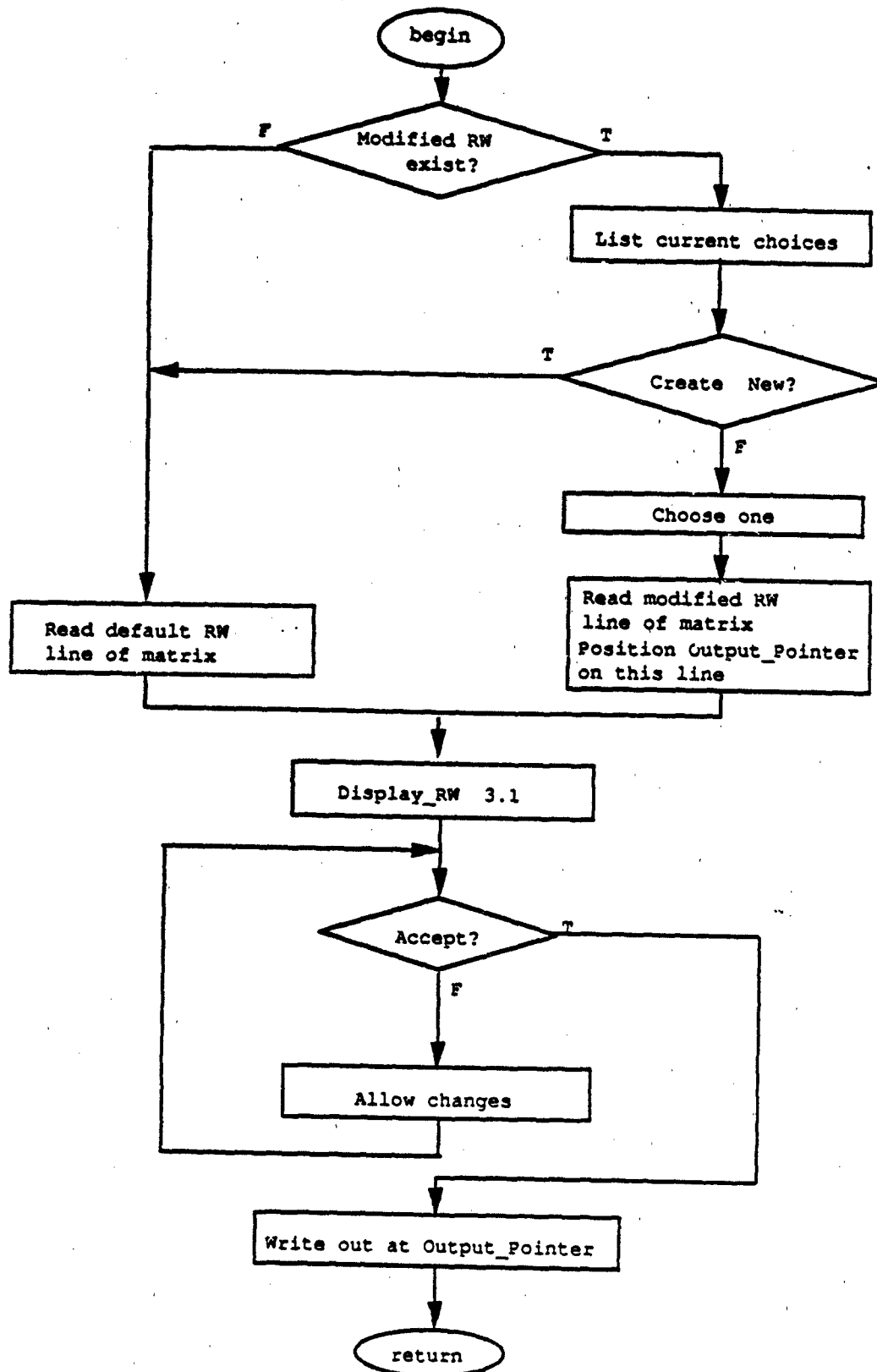


FIGURE 4.7. RW\_PARAMS 3.0

given the opportunity to accept it as is, or tailor it to his current needs. The parameter allowing the entry of the time range (real time) is used to estimate when a (RW) event should be expected to start. The time range is used as a constraint of possible times, and the exact time of onset will be determined by the random number generator. When the RW variables are accepted, they will be written out to the appropriate position in the internally stored matrix.

#### 4.2.4.1 3.1 Display\_RW

The purpose of the "Display\_RW" module (Reference Figure 4.8) is to provide a pre-formatted screen on which to present the current RW parameters to the instructor for update.

#### 4.2.5 4.0 Fire Params

The purpose of the "Fire\_Params" module (Reference Figure 4.9) is to enter the Fire scenario parameters into the matrix. If any lines in the matrix below line six (Reference Figure 4.2) already exists that contain Fire information, then a list of the existing Fire records is presented to the instructor, as the instructor may desire to update one of the existing records or create a new Fire record. According to whether one of the existing Fire records is chosen or not will decide which line of Fire information to read from the matrix, the previously entered Fire or the default Fire record. The information from the line is displayed, and the instructor is given the opportunity to accept it as is, or tailor it to his current needs. The parameter allowing the entry of the time range (real time) is used to estimate when a (Fire) event should be expected to start. The time range is used as a constraint of possible times, since the exact time of onset will be determined by the random number generator. When the Fire variables are accepted, they will be written out to the appropriate position in the internally stored matrix.



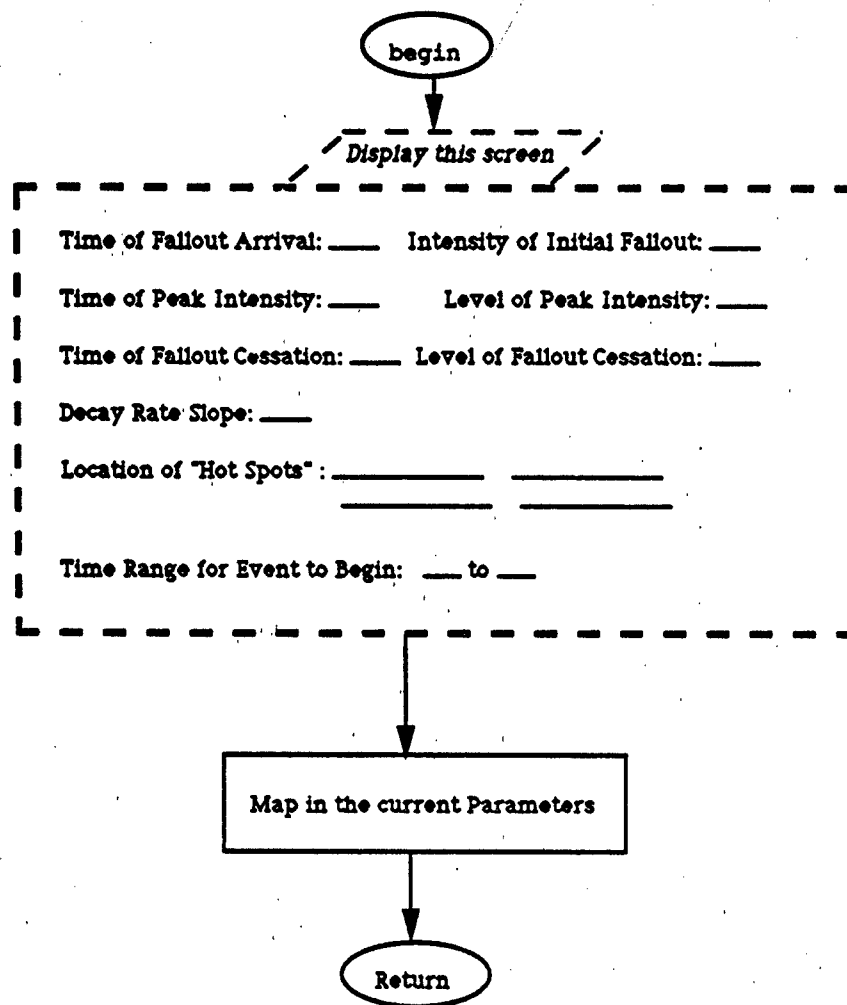


FIGURE 4.8. DISPLAY\_RW 3.1

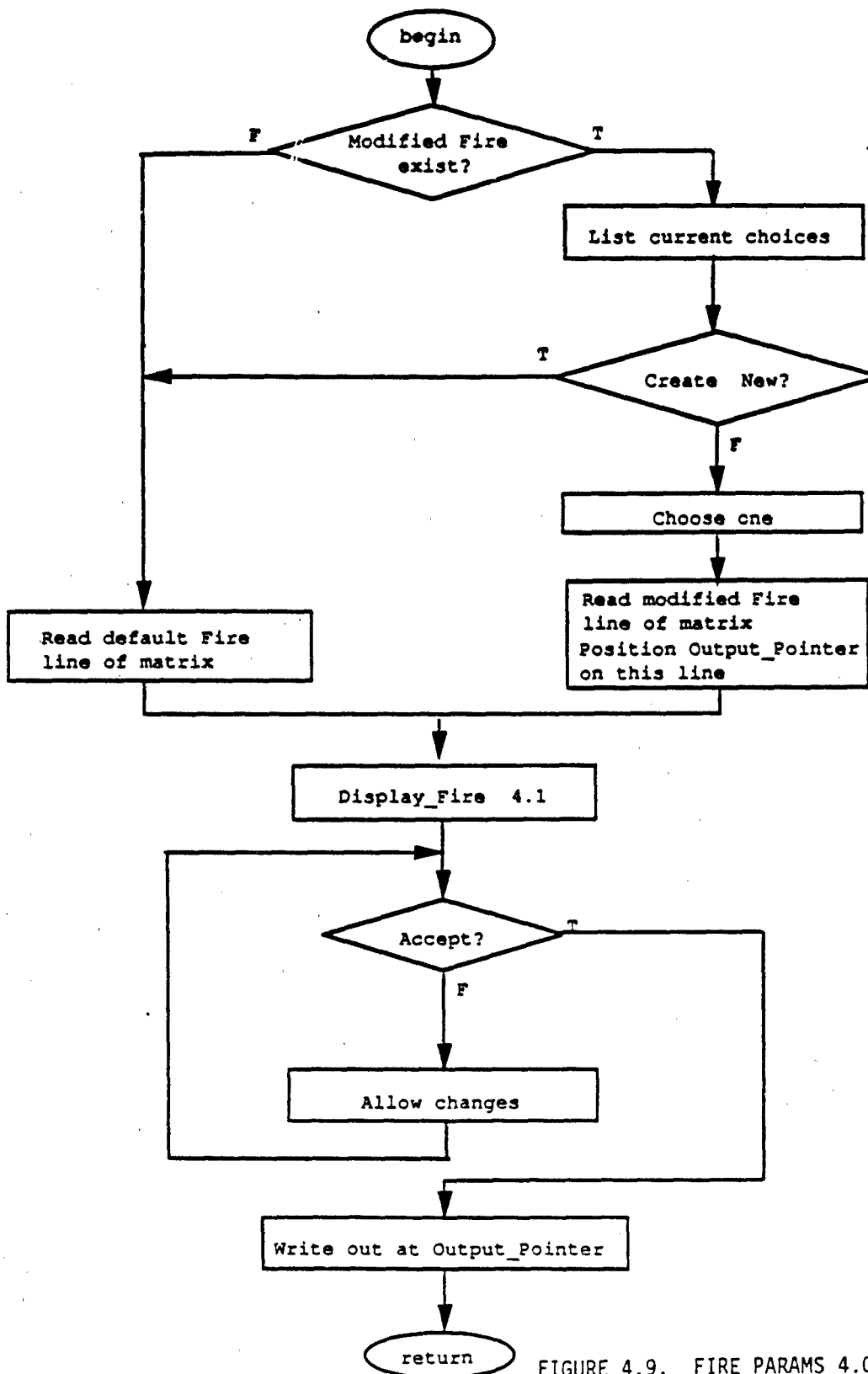


FIGURE 4.9. FIRE\_PARAMS 4.0

#### 4.2.5.1 4.1 Display\_Fire

The purpose of the "Display\_Fire" module (Reference Figure 4.10) is to provide a pre-formatted screen on which to present the current Fire parameters to the instructor for update.

#### 4.2.6 5.0 Flood Params

The purpose of the "Flood\_Params" module (Reference Figure 4.11) is to enter the Flood scenario parameters into the matrix. If any lines in the matrix below line six (Reference Figure 4.2) already exists that contain Flood information, then a list of the existing Flood records is presented to the instructor, as the instructor may desire to update one of the existing Flood records or create a new Flood record. According to whether one of the existing Flood records is chosen or not will decide which line of Flood information to read from the matrix, the previously entered Flood or the default Flood record. The information from the line is displayed, and the instructor is given the opportunity to accept it as is, or tailor it to his current needs. The parameter allowing the entry of the time range (real time) is used to estimate when a (Flood) event should be expected to start. The time range is used as a constraint of possible times, since the exact time of onset will be determined by the random number generator. When the Flood variables are accepted, they will be written out to the appropriate position in the internally stored matrix.

#### 4.2.6.1 5.1 Display\_Flood

The purpose of the "Display\_Flood" module (Reference Figure 4.12) is to provide a pre-formatted screen on which to present the current Flood parameters for update to the instructor.

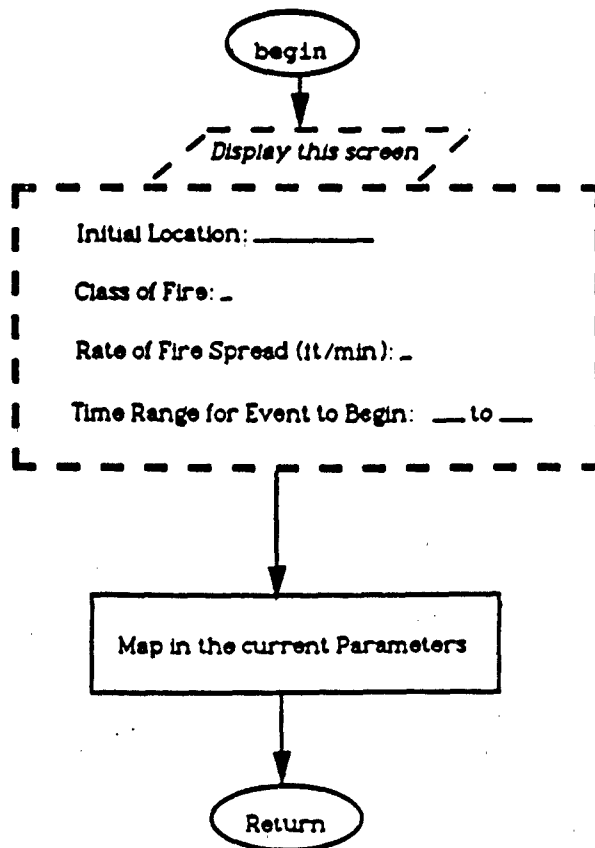


FIGURE 4.10. DISPLAY\_FIRE 4.1

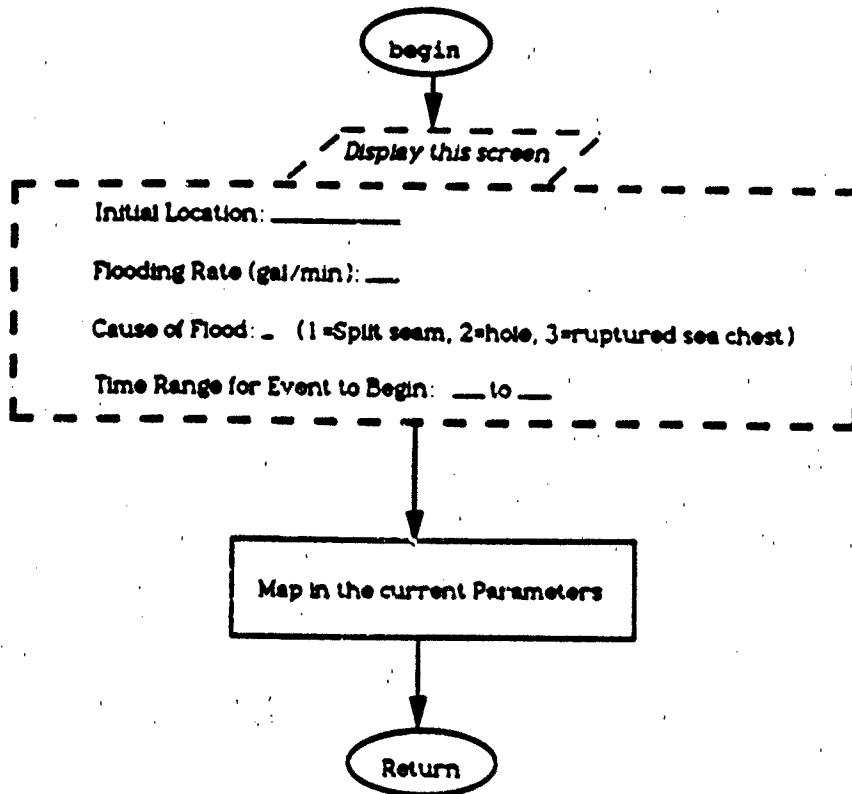


FIGURE 4.12. DISPLAY\_FLOOD 5.1

#### 4.2.7 6.0 Incidental List

The purpose of the "Incidental\_List" module (Reference Figure 4.13) is to allow the instructor to choose which Incidental Situations to pose to the student during the scenario exercise. If a line in the matrix below line six (Reference Figure 4.2) already exists that contains Incidental Situation information, then that line is read from the matrix (since only one Incidental Situation line can exist), otherwise the default Incidental Situation line is read. The information from the line is displayed, and the instructor is given the opportunity to accept it as is, or tailor it to his current needs. When the list of Incidentals is accepted, it is written out to the appropriate position in the matrix. The parameter allowing the entry of the time range (real time) is used to decide when an Incidental Situation or Event will occur in respect to on-going major events. The time range is used as a constraint of possible times, since the exact time of onset will be determined by a random number generator. When the Incidental Situation variables are accepted, they will be written out to the appropriate position in the internally stored matrix.

##### 4.2.7.1 6.1 Display\_Incidentals

The purpose of the "Display\_Incidentals" module (Reference Figure 4.14) is to provide a pre-formatted screen on which to present the list of Incidentals (Situations or Events) available to the instructor along with the currently chosen Incidentals.

#### 4.2.8 7.0 View

Upon completion of the Initial Conditions Matrix, the instructor may review the various parameter values. The "View" module (Reference Figure 4.15) provides the instructor with an easy way to review the parameters that he has entered into the Initial Conditions Matrix for the chosen scenario. The purpose of this module is for retrieval only; actual updating of the variables must be done through the appropriate "TYPE\_Param" module.

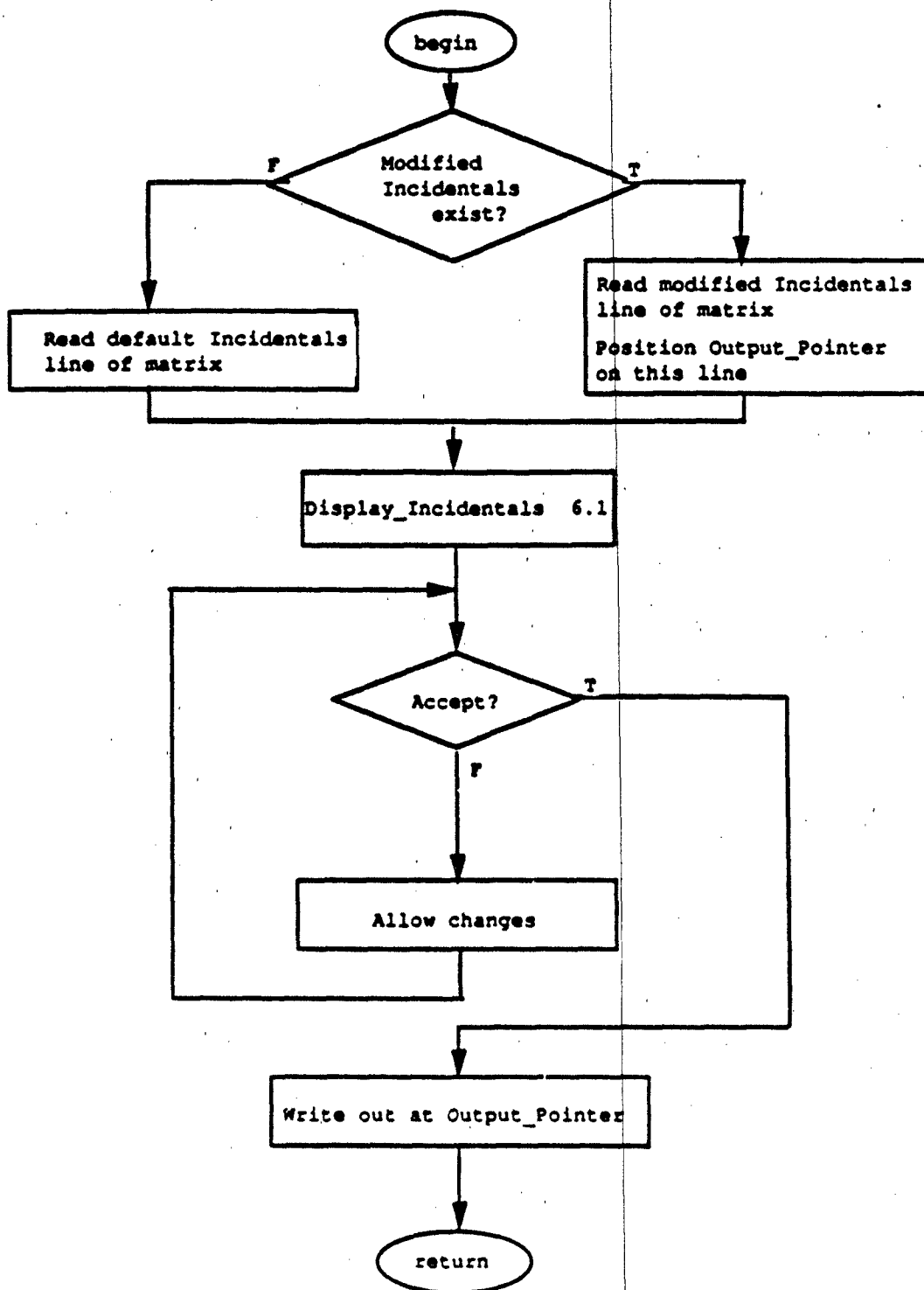


FIGURE 4.13. INCIDENTAL\_LIST 6.0

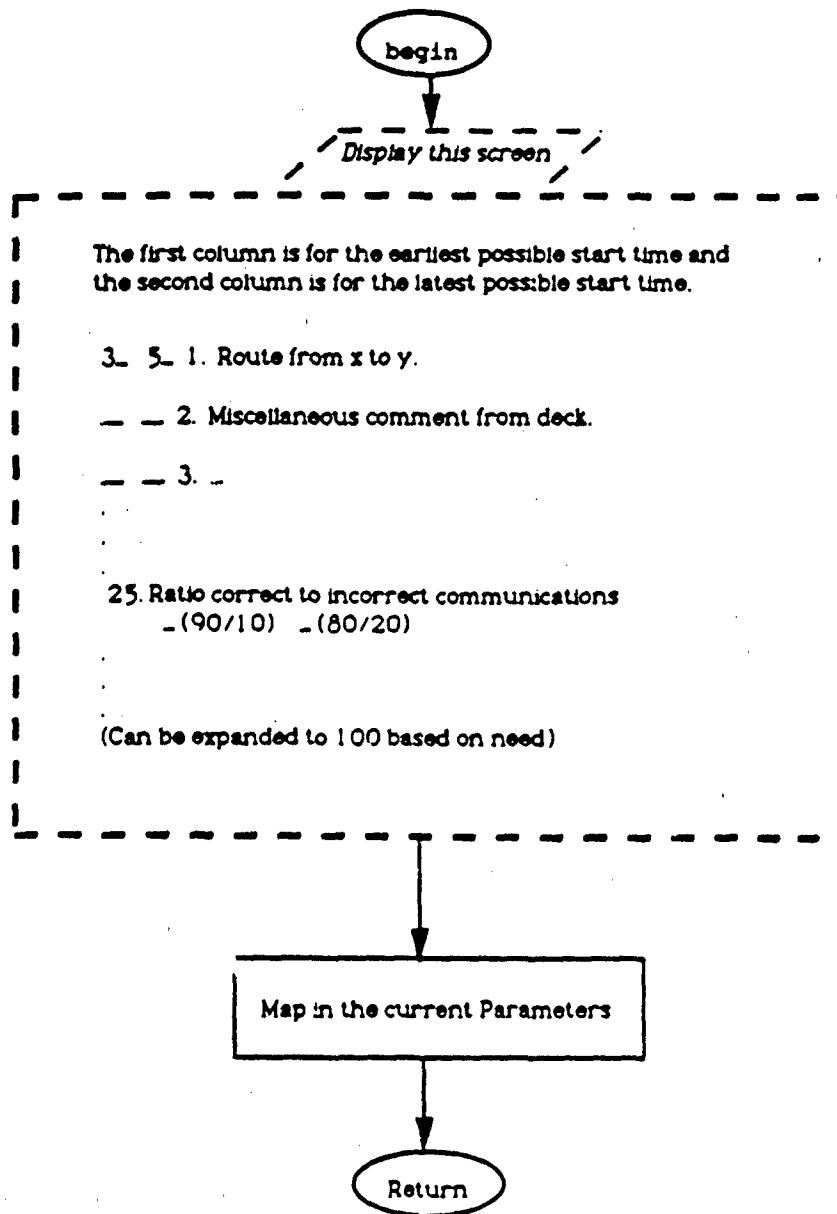


FIGURE 4.14. DISPLAY\_INCIDENTALS 6.1



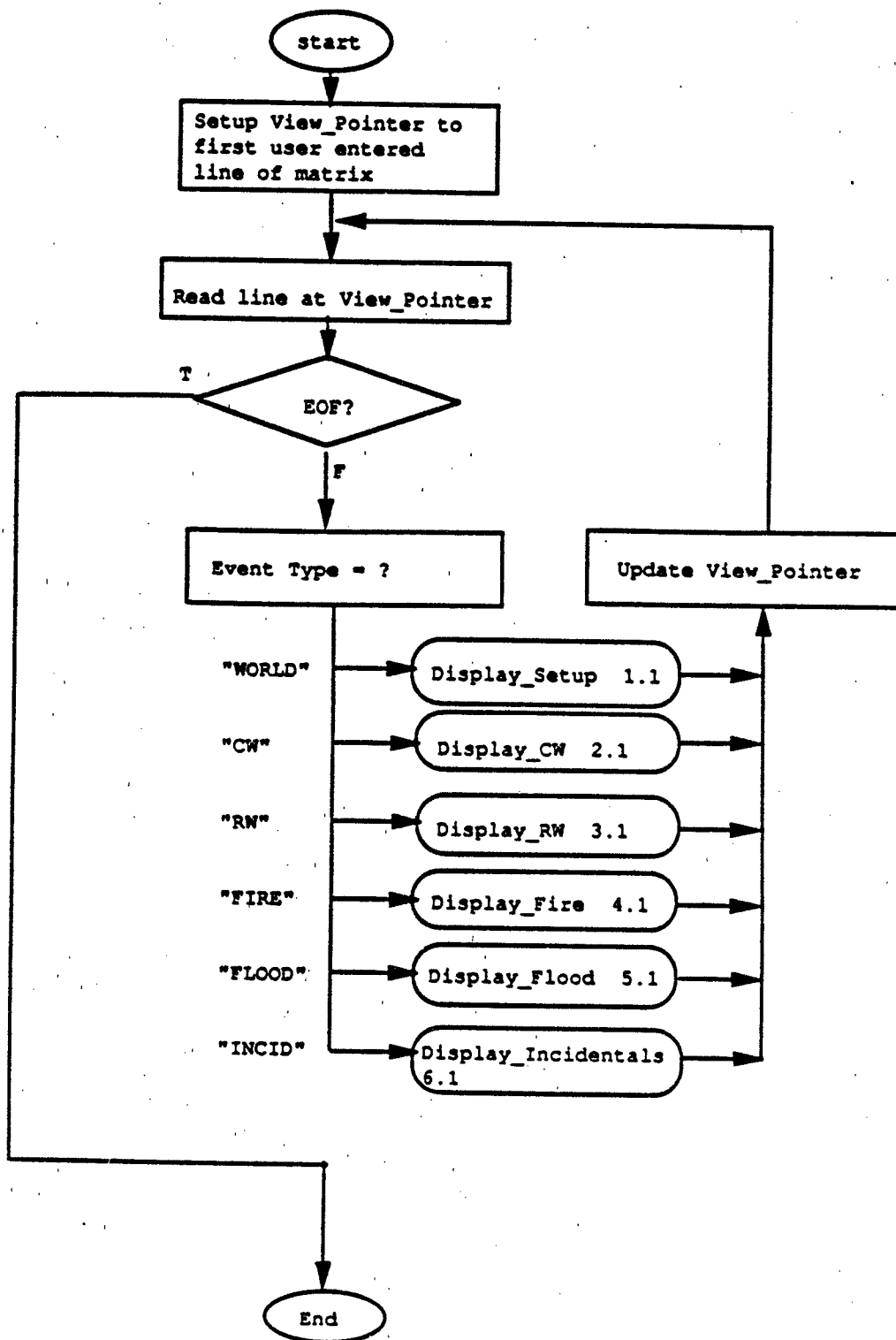


FIGURE 4.15. VIEW 7.0

### 4.3 DETAILED DESIGN - EXECUTIVE

In this section, the Detailed Design Specification for the major module "Executive" is developed and presented.

#### 4.3.1 0.0 Executive

The purpose of the "Executive" module (Reference Figure 4.16) is to be the central control point of the entire on-going scenario. The first time after the system is turned on the "Executive" module is executed and will initialize both the Play-Back and Rerun variables to false. This is necessary because for the first pass through the system, the "Executive" can neither be in the play-back nor rerun mode. Subsequent executions that the user requests can be a play-back request or a rerun request. The "Executive" then invokes the "Initialization" module in order that the various scenario variables can be loaded. The Executive module will then start both the scenario and system clocks; and, it will display the initial screen(s) as loaded into memory by the "Initialization" module. The displaying of screens will be initiated by a call to existing software that is specifically designed for the purpose of reading bit maps and text in from the hard disk to primary memory and then, when appropriate, to the screen for display. The system clock time will be read by the use of a system call in order to sequence events and provide a time history throughout the scenario. The "Executive" module will then cycle through its algorithms/routines (described below), checking for input from the user or from the scenario events. These activities will continue until the scenario is completed. Completion is determined if time runs out, the user quits, a fatal disaster occurs, or the user successfully completes the scenario. Once play is complete, the user will be presented with feedback concerning his actions and decisions; the nature of this feedback will be determined in future DECAID development efforts. The user will then be offered the chance to play back the scenario and responses, run the same scenario, or run a different scenario. Note that if the user runs the same scenario again, probability branches within it (see Section 4.6) may lead to a different set of contingencies, consequences, and screen displays.

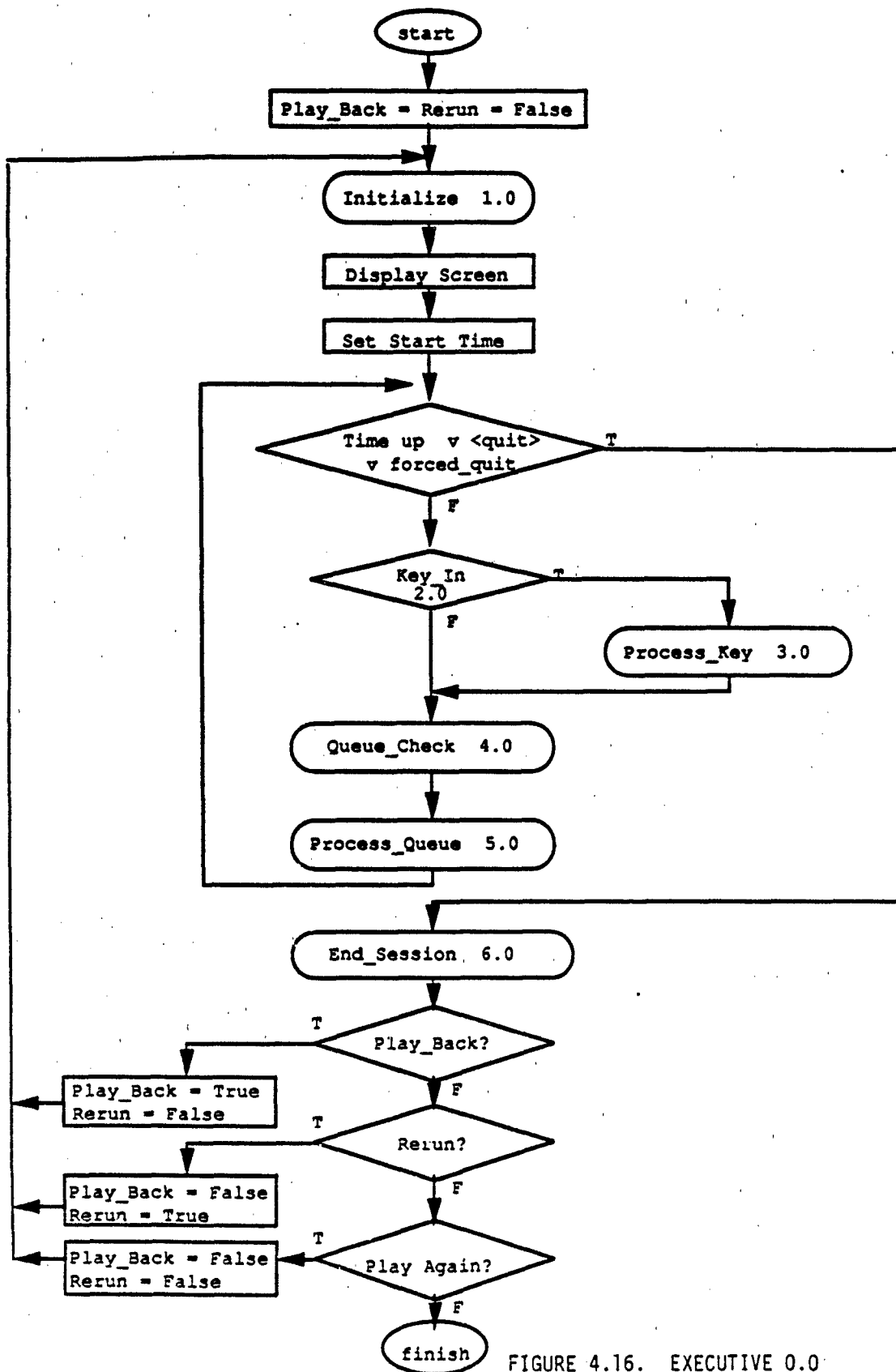


FIGURE 4.16. EXECUTIVE 0.0

#### 4.3.2 1.0 Initialization

The purpose of the "Initialization" module (Reference Figure 4.17) is to initialize the scenario variables, materials, crew, and backgrounds according to the scenario's Initial Conditions Matrix, which had been designed and entered by the instructor. If the user has opted to play a previous scenario again, the old seed (for the random number generator) is to be maintained and the old matrix is to be used for initialization. To run a new scenario, a new random number generation seed is produced and a new matrix is used for initialization. Based on either of these two decisions, the User\_Input file will either be opened to recreate the responses made by the user, or a new User\_Input file will be opened.

To establish the random number generator seed, the rightmost three bits of the system clock will be used. The purpose of the User\_Input file is to record and time-tag the responses of the user in the order that they occurred.

The appropriate matrix will be read line by line, and depending on the "type" of the event (i.e., Fire, Flood, RW, CW, etc.), the appropriate Setup routine will be invoked. However, all events of the same type will have static column boundaries. The System\_Input file will be opened to accept time-tagged information produced during the conduct of the scenario. These data are then saved and can be made available for later presentation and feedback.

##### 4.3.3.1 1.1 World\_Setup

The purpose of the World\_Setup module (Reference Figures 4.18a and 4.18b) is to initialize the global variables associated with the internal and external environment, alert status, material status, logistics inventory status, and personnel status. The pre-determined system constraints (Reference Table 4.4) are also initialized in this setup routine. The World\_Setup module will be initiated only when the type of the event is "WOPLD". These variables are only initialized by this module and can be altered during the course of scenario play. For example, if crew size in a repair locker

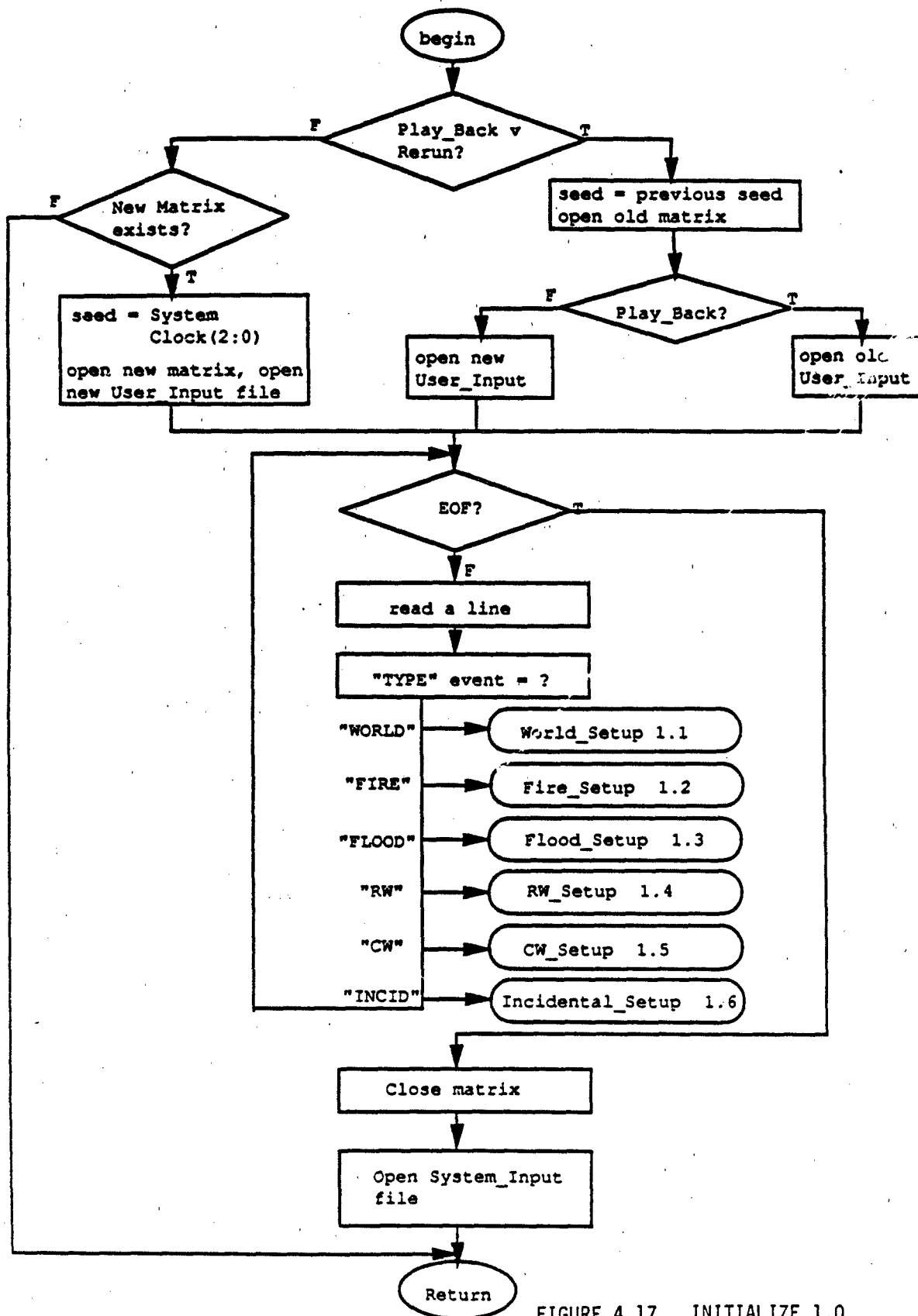


FIGURE 4.17. INITIALIZE 1.0

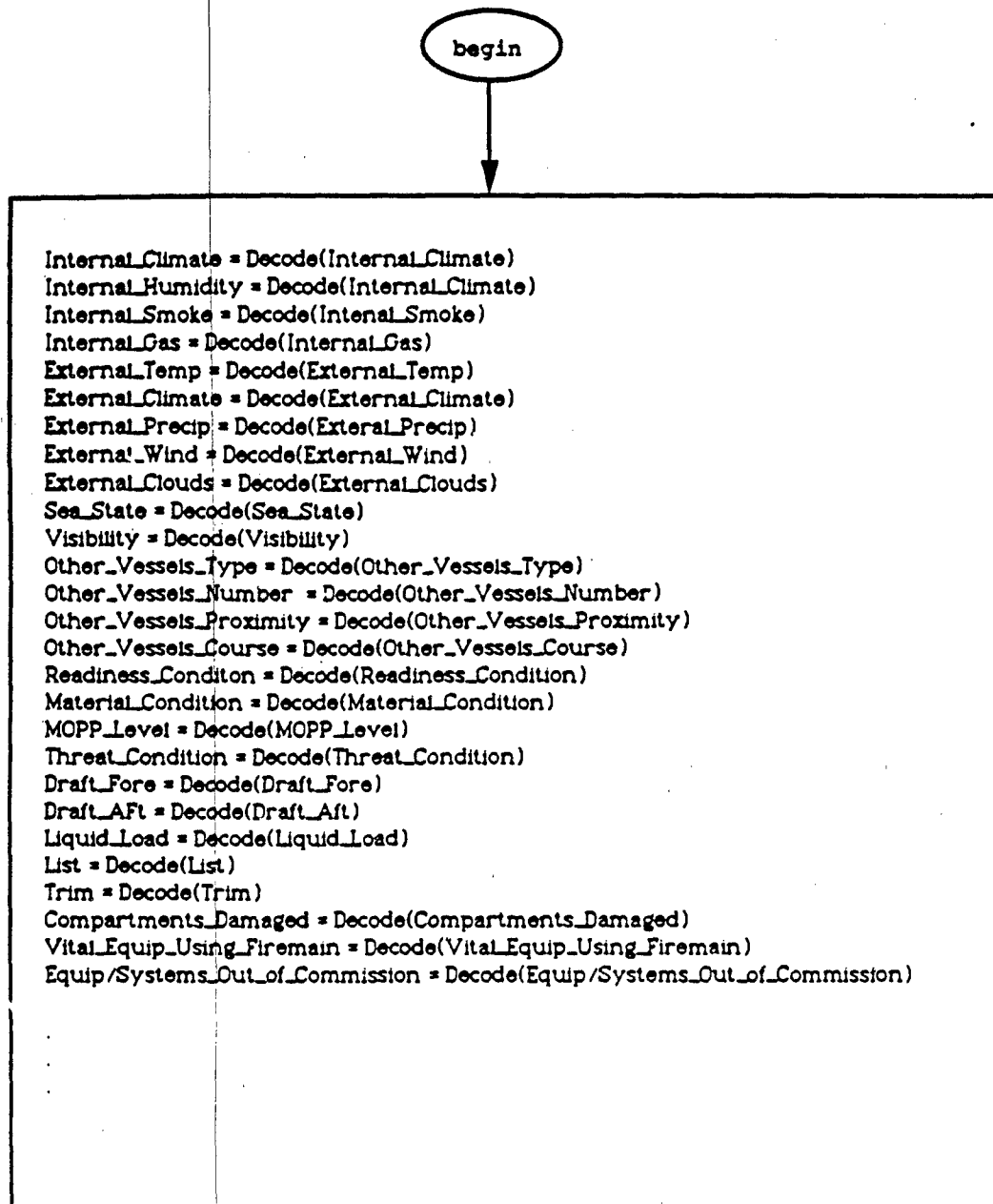


FIGURE 4.18a. WORLD\_SETUP 1.1

```
Inventory_Gas_Mask_Canisters = Decode(Gas_Mask_Canisters)
Inventory_OBA_Canisters = Decode(OBA_Canisters)
Inventory_Unopened_Clothes = Decode(Unopened_Clothes)
Inventory_Halon_Bottles = Decode(Halon_Bottles)
Inventory_CO2_Bottles = Decode(CO2_Bottles)
Inventory_SAFF = Decode(SAFF)
Inventory_M258 = Decode(M258)
Inventory_M256 = Decode(M256)
Inventory_Calcium_Hypochlorite = Decode(Calcium_Hypochlorite)
Inventory_M8_Paper = Decode(M8_Paper)
Inventory_Gasoline = Decode(Gasoline)
Training_Level_Fire = Decode(TL_Fire)
Training_Level_Flood = Decode(TL_Flood)
Training_Level_CBR-D = Decode(TL_CBR-D)
Training_Level_Repair2 = Decode(TL_Repair2)
Training_Level_Repair3 = Decode(TL_Repair3)
Training_Level_Repair5 = Decode(TL_Repair5)
Manning_Level = Decode(Manning_Level)
Casualty_Repair2_Leader = Decode(C_Repair2_Leader)
Casualty_Repair2_OBA = Decode(C_Repair2_OBA)
Casualty_Repair3_Leader = Decode(C_Repair3_Leader)
Casualty_Repair3_OBA = Decode(C_Repair3_OBA)
Casualty_Repair5_Leader = Decode(C_Repair5_Leader)
Casualty_Repair5_OBA = Decode(C_Repair5_OBA)
Fatigue_Level = Decode(Fatigue_Level)
Prior_Exposure_Radiation = Decode(Prior_Exp_Radiation)
Prior_Exposure_Chemical = Decode(Prior_Exp_Chemical)
Constraints = Decode(Constraints)
```

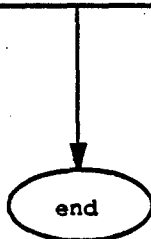


FIGURE 4.18b.





decreases due to personnel casualties, the "locker manning level" parameter will be decreased appropriately. Later in the scenario, if this locker party is required to perform, the decrease in crew members will result in an increase in task completion time, an increase in the likelihood that the damage will not be contained, or perhaps both. These degradations in human performance will be set by degradation coefficients, referenced in Table 4.4, the details of which will be determined at the next phase of DECAID system development. Algorithms will be developed for applying these constraints by accessing a rule base of IF-THEN-ELSE rules.

#### 4.3.3.2 1.2 Fire\_Setup

The purpose of the Fire\_Setup (Reference Figure 4.19) module is to initialize the variables associated with the Fire events, such as initial location, class of fire, and rate of spread. The Fire\_Setup module will be initiated when the type of the event is "FIRE". The variables are only initialized by this module and can be altered during the course of scenario play. The variables will be set by decoding the array of bits on the same line as the "FIRE" type. The screens associated with the variables will be accessed and loaded by the system software, and will be placed in time-order on the queues.

#### 4.3.3.3 1.3 Flood\_Setup

The purpose of the Flood\_Setup module (Reference Figure 4.20) is to initialize the variables associated with the Flood event, such as initial location, flooding rate, and cause of flood. The Flood\_Setup module will be initiated when the type of the event is "FLOOD". The variables are only initialized by this module and can be altered during the course of scenario play. The variables will be set by decoding the array of bits on the same line as the "FLOOD" type. The screens associated with the variables will be accessed and loaded by the system software, and will be placed in time-order on the queues.

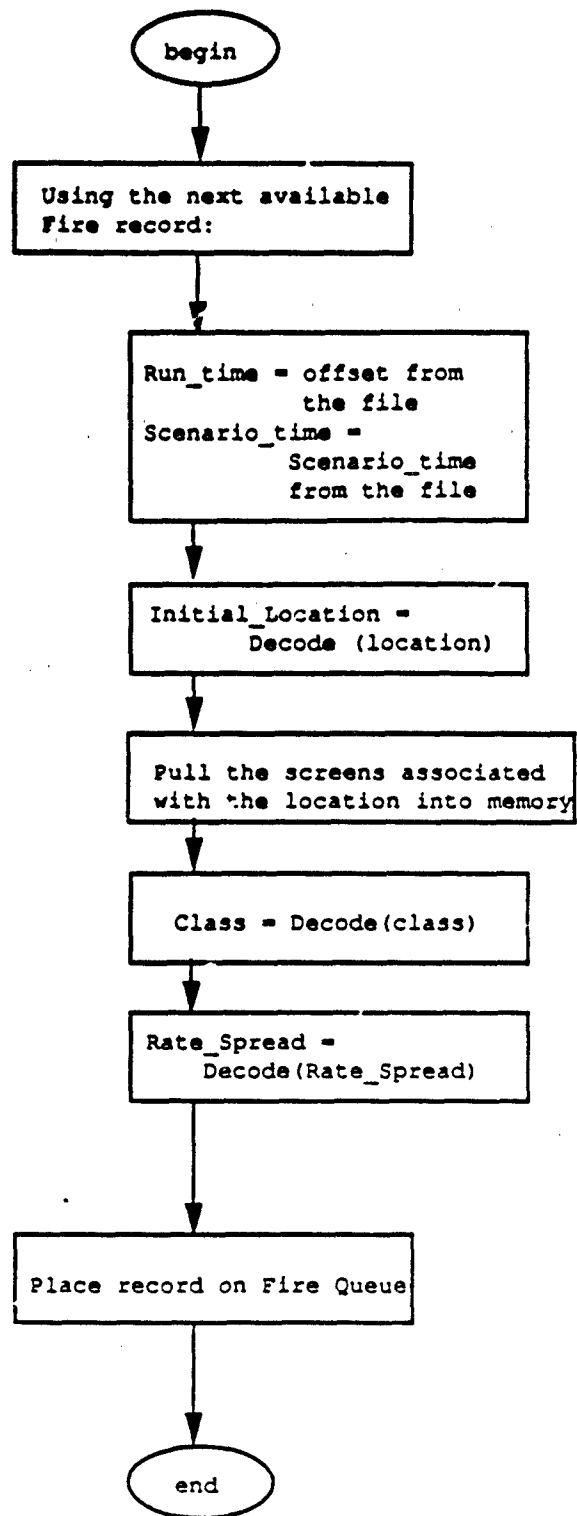


FIGURE 4.19. FIRE\_SETUP 1.2

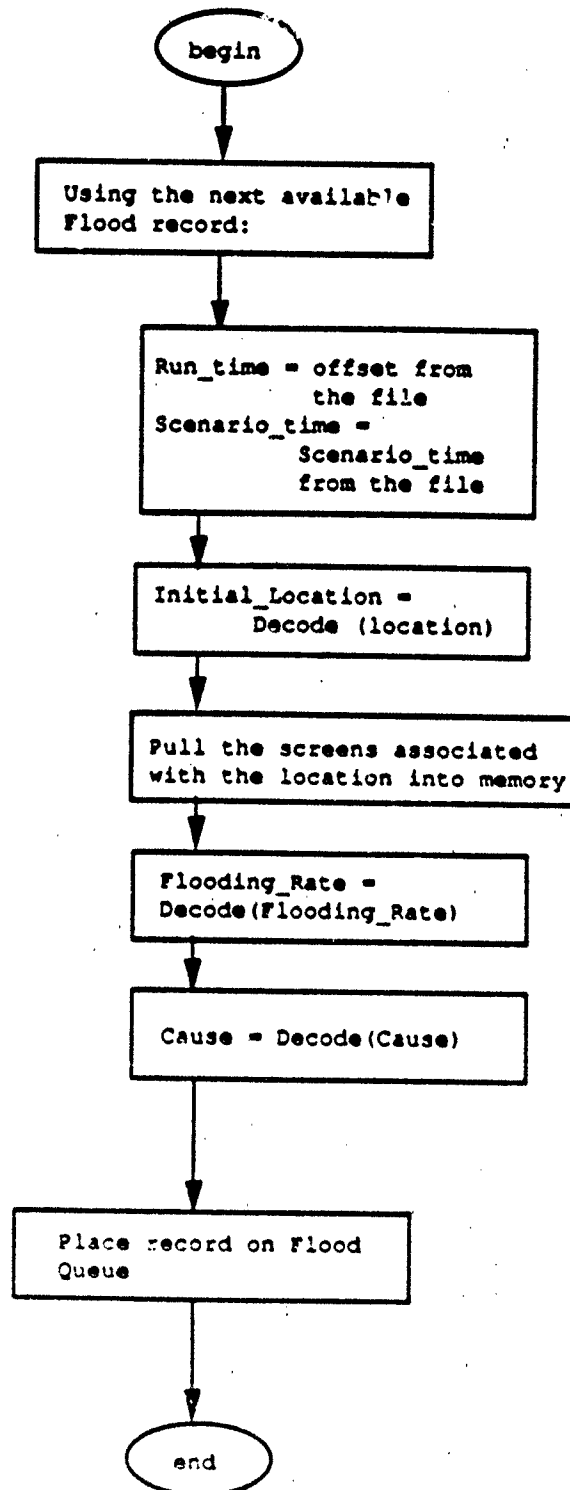


FIGURE 4.20. FLOOD\_SETUP 1.3

#### 4.3.3.4 1.4 RW\_Setup

The purpose of the RW\_Setup module (Reference Figure 4.21) is to initialize the variables associated with the Radiological Warfare event, such as time and intensity of fallout, time and level of peak intensity, time and level of fallout cessation, decay rate slope, and location of "hot" spots. The RW\_Setup module will be initiated when the type of the event is "RW". The variables are only initialized by this module and can be altered during the course of scenario play. The variables will be set by decoding the array of bits on the same line as the "RW" type. The screens associated with the variables will be accessed and loaded by the system software, and will be placed in time-order on the queues.

#### 4.3.3.5 1.5 CW\_Setup

The purpose of the CW\_Setup module (Reference Figure 4.22) is to initialize the variables associated with the Chemical Warfare event, such as type of agent, point of initial detection, rate of spread, and location of "hot" spots. The CW\_Setup module will be initiated when the type of the event is "CW". The variables are only initialized by this module and can be altered during the course of scenario play. The variables will be set by decoding the array of bits on the same line as the "CW" type. The screens associated with the variables will be accessed and loaded by the system software, and will be placed in time-order on the queues.

#### 4.3.3.6 1.6 Incidental\_Setup

The purpose of the Incidental\_Setup routine (Reference Figure 4.23) is to load into memory the representative screens for the incidental tasks that were chosen to appear by the instructor. The start time for the incidental task will be determined by randomly generating a number between the two times entered for this incidental. The Incidental-Setup module will be initiated when the type of the event is "INCID".

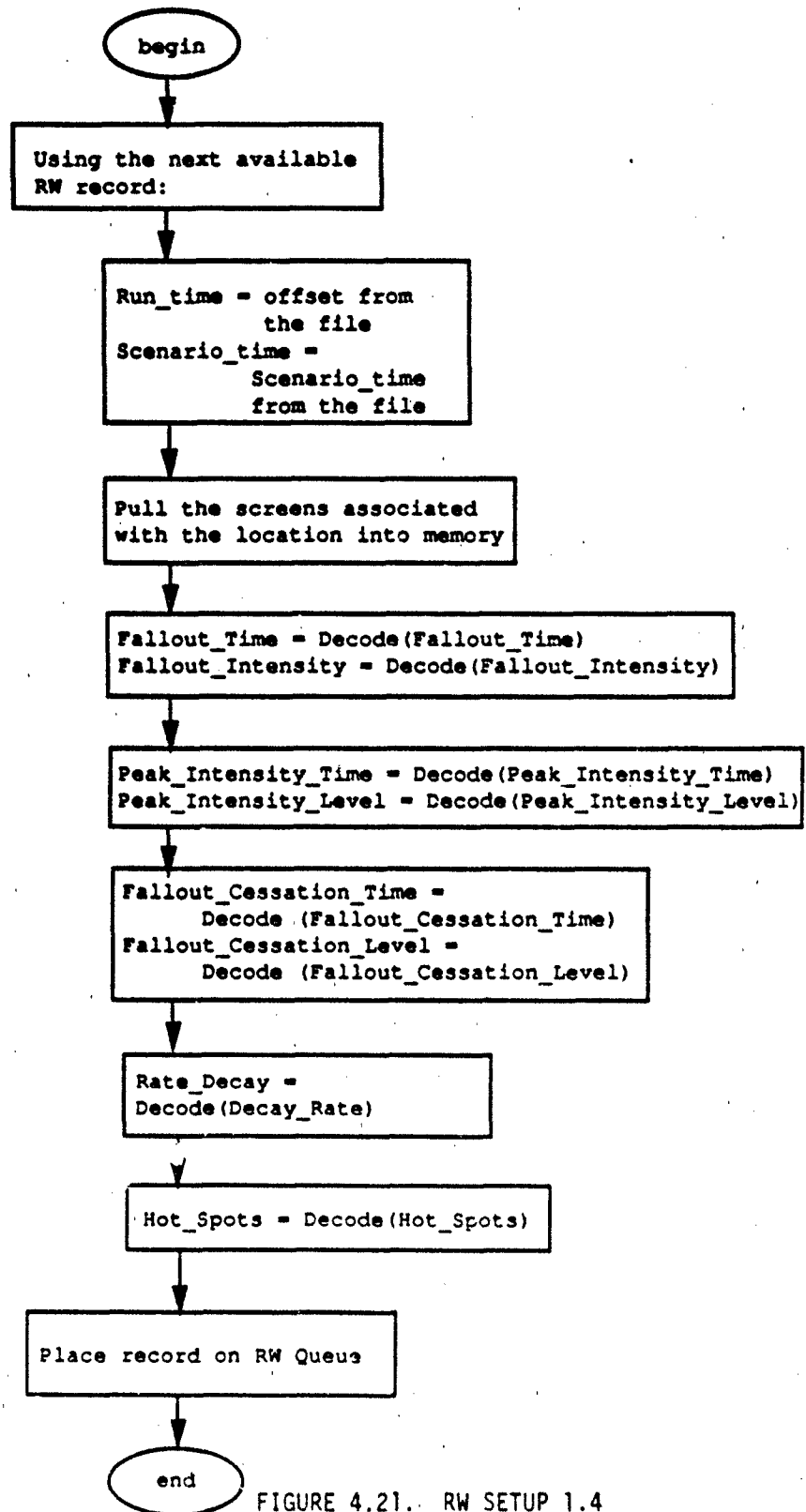


FIGURE 4.21. RW\_SETUP 1.4

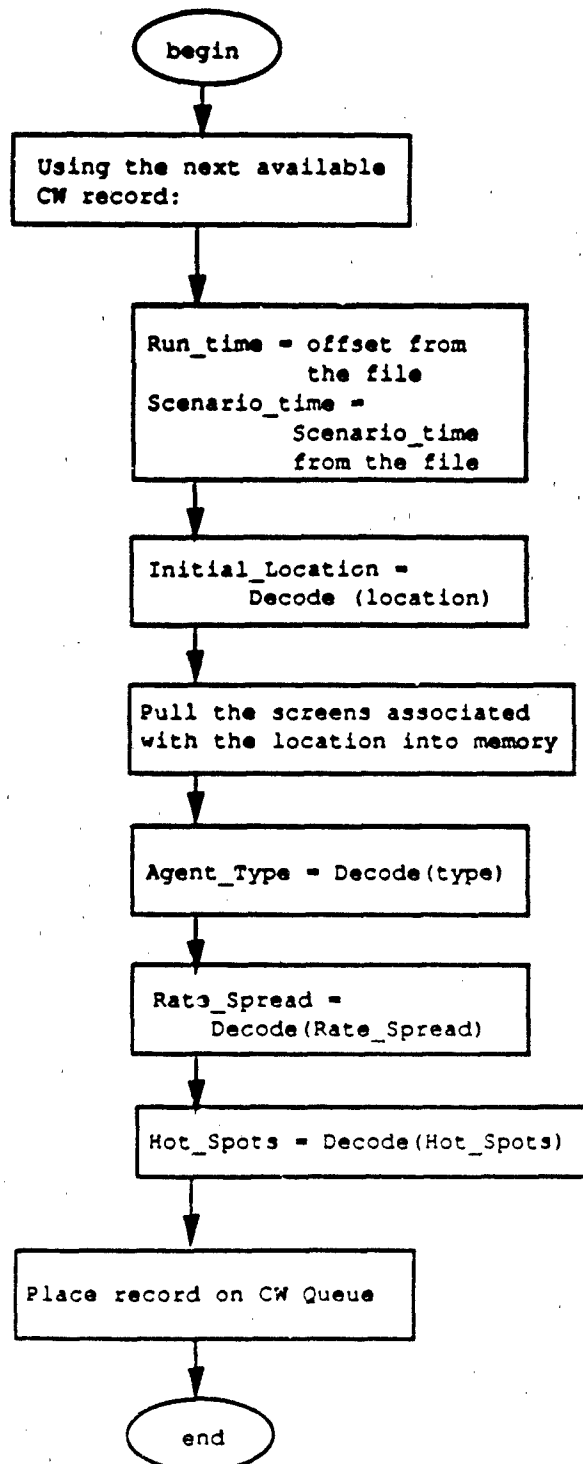


FIGURE 4.22. CW\_SETUP 1.5

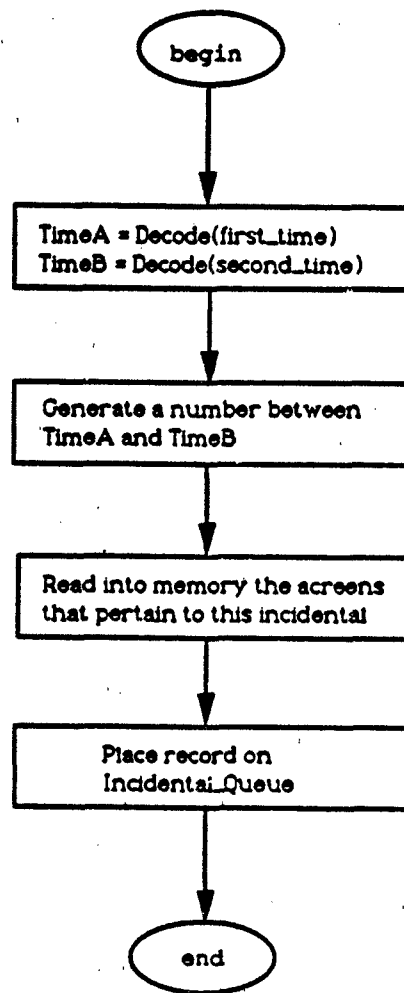


FIGURE 4.23. INCIDENTAL\_SETUP 1.6

#### 4.3.4 2.0 Key In

The purpose of the Key\_In module (Reference Figure 4.24) is to monitor the keyboard or screen for user input via keyboard or mouse (depending on what type of input device is used). If the user is playing back a scenario, then the input file created by the previous play by the user is used as the input. At this point, input is not accepted from the keyboard, and the user can not change his previous responses. For future changes or modifications to the scenario generation system, if for example, the Master Chief is implemented (see Tijerina, et. al., 1988), it may be possible to allow the Master Chief to interject, during play-back, with the optimal response to the situation. If the user is running a scenario again or playing a new one, the input is accepted from the keyboard or screen. When the user takes an action, the action is reported and recorded.

#### 4.3.5 3.0 Process Key

The purpose of the Process\_Key module (Reference Figure 4.25) is to interpret the user's actions. Depending on the user's response, this module may:

1. Place a communication panel on hold (WAIT). This places it on the appropriate queue to be brought back to the user's attention at a predetermined time.
2. Answer a question posed by a communication panel that will effect the status of the ship, crew, inventory, etc.
3. Be miscellaneous input for an incidental task. This information can be stored for later evaluation or presentation.
4. Request a communication panel to help with the decision making, such as requesting to see pump pressure or the clinometer.
5. Change the region of the ship presented on the screen.
6. Impact global variables.



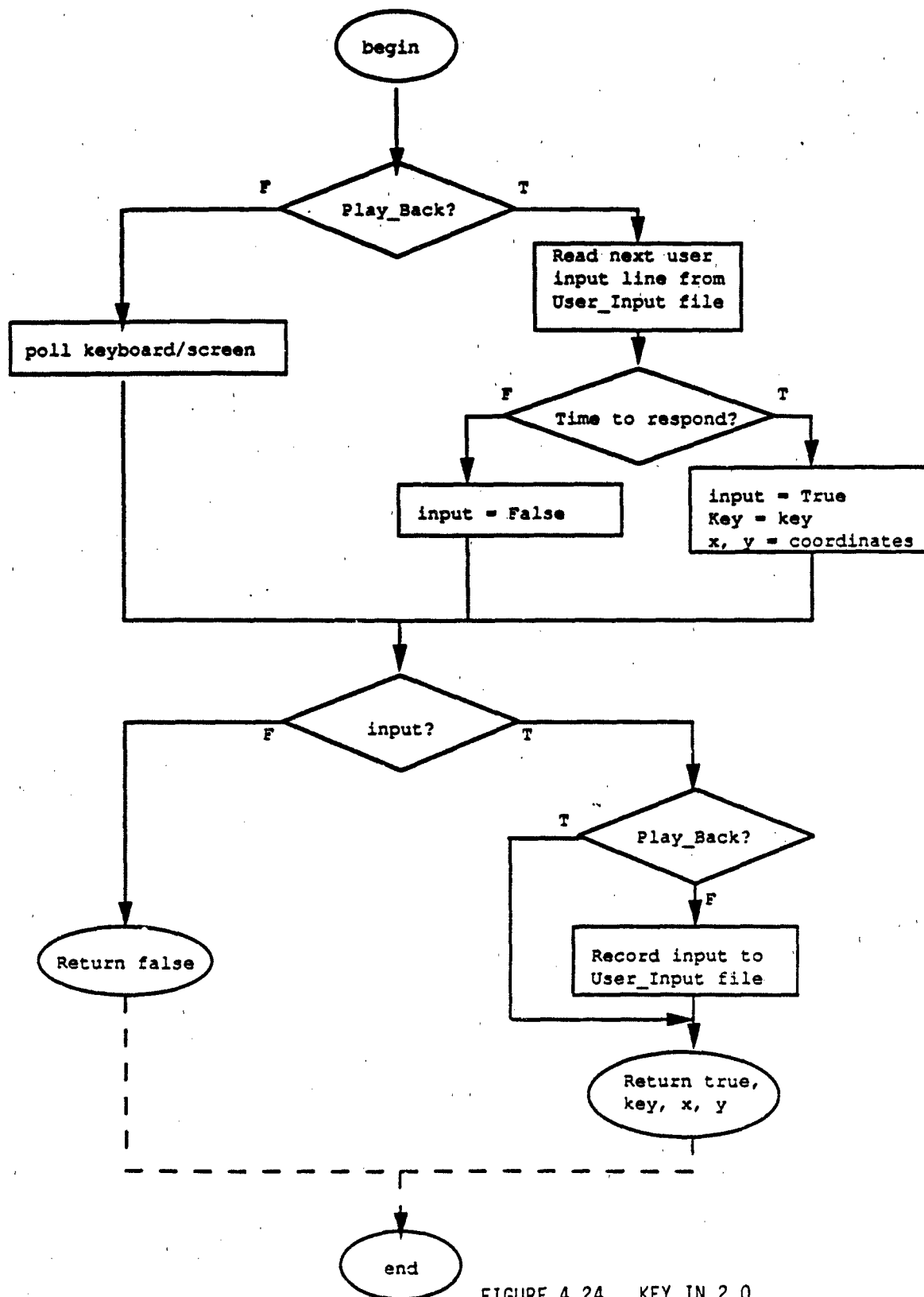


FIGURE 4.24. KEY\_IN 2.0

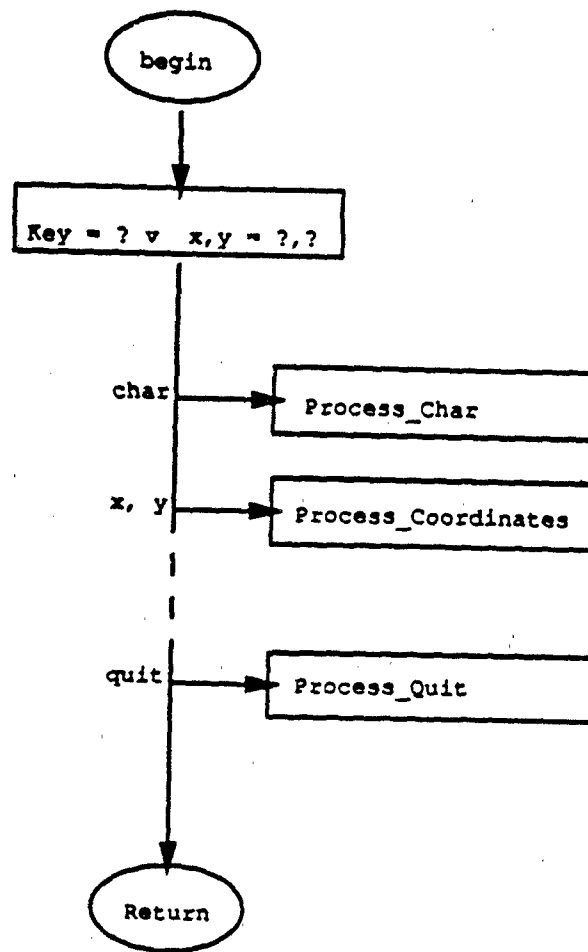


FIGURE 4.25. PROCESS\_KEY 3.0

#### 4.3.6 4.0 Queue Check

The purpose of the Queue\_Check module (Reference Figure 4.26) is to constantly poll the various queues representing the events to take place. The queue will be ordered by time, with the soonest event to happen having the lowest index. Queue\_Check will compare the current time to the top item on each queue. If the current time is greater than or equal to the start time of the event, then the event is placed on the Active\_Queue. The next item on the event queue will be considered to see if it too can be placed on the Active\_Queue. Queue\_Check will proceed to the next event queue when the current queue being checked either becomes empty, or the entry with the lowest index has a time less than the current time.

Each event needs to have its own clock. When an event is initiated, the event clock will start and will be "powered" by the system clock. The separate clocks are necessary because within an ongoing event, an additional event may be specified to occur at a specific time from the beginning of the current event, not the scenario. The separate clocks will allow the ability to have several events running in parallel, and will handle time overlap. They will, in effect, appear as interrupts to the current event.

Initially, each queue will contain the events that the setup matrix determined would happen. The queues will be altered as a consequence of the user's actions. The Active\_Queue initially will contain the opening screen.

#### 4.3.7 5.0 Process Queue

The purpose of the Process-Queue module (Reference Figure 4.27) is to watch the Active\_Queue. Items will be read and acted upon according to their event type. The screens that are presented to the user are dependent-on, and are loaded-in by the TYPE\_Process (Figure 4.27, see also sections 4.3.7.1 through 4.3.7.6). Each of the TYPE\_Processes will be associated with a static decision tree, and according to the user's actions, current tree position, and the random number generator, the next position will be determined. See Section 4.6 and Figure 4.34 for a discussion of decision trees as it relates to this task. The needed changes to the global variables

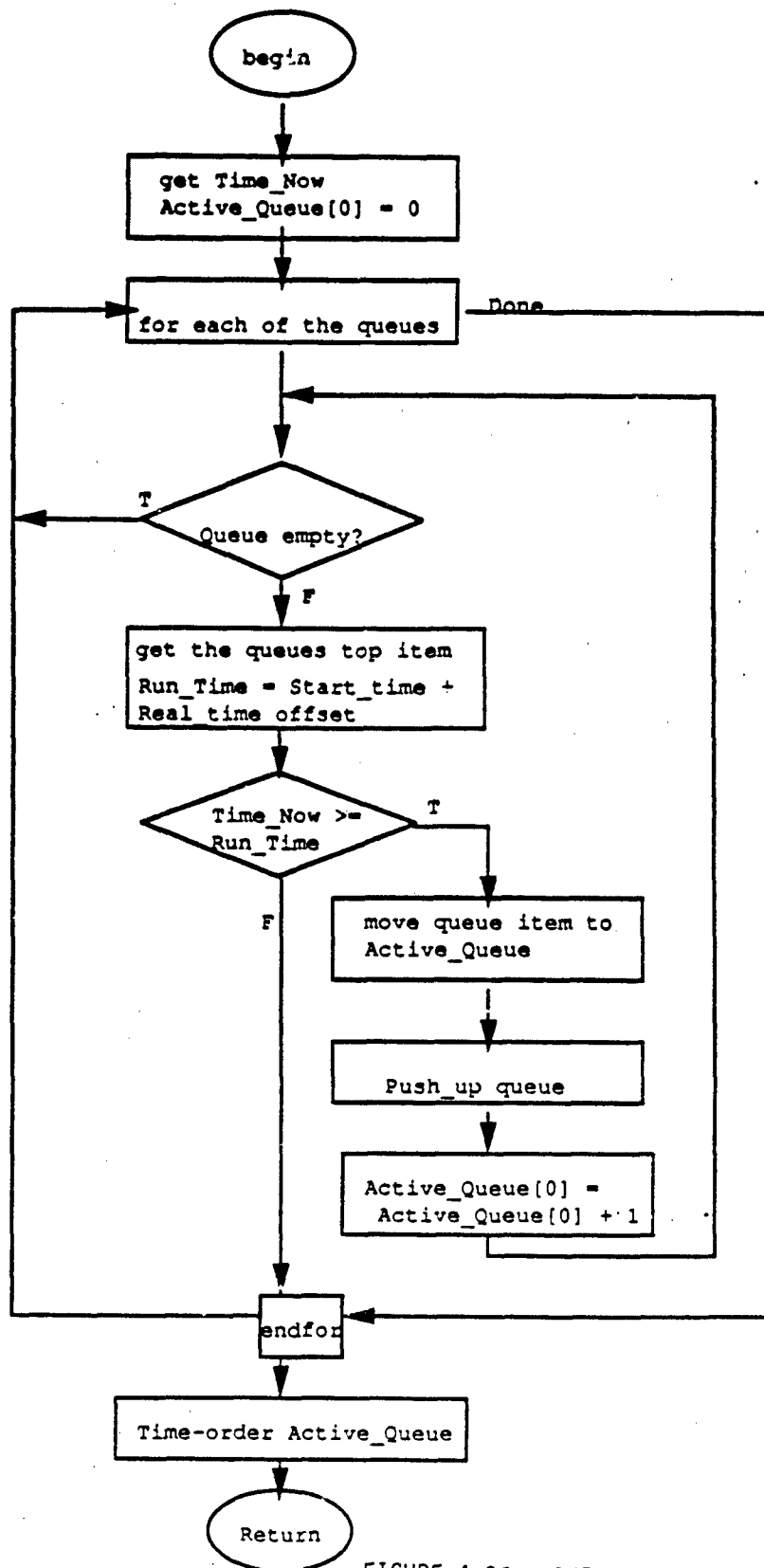


FIGURE 4.26. QUEUE\_CHECK 4.0

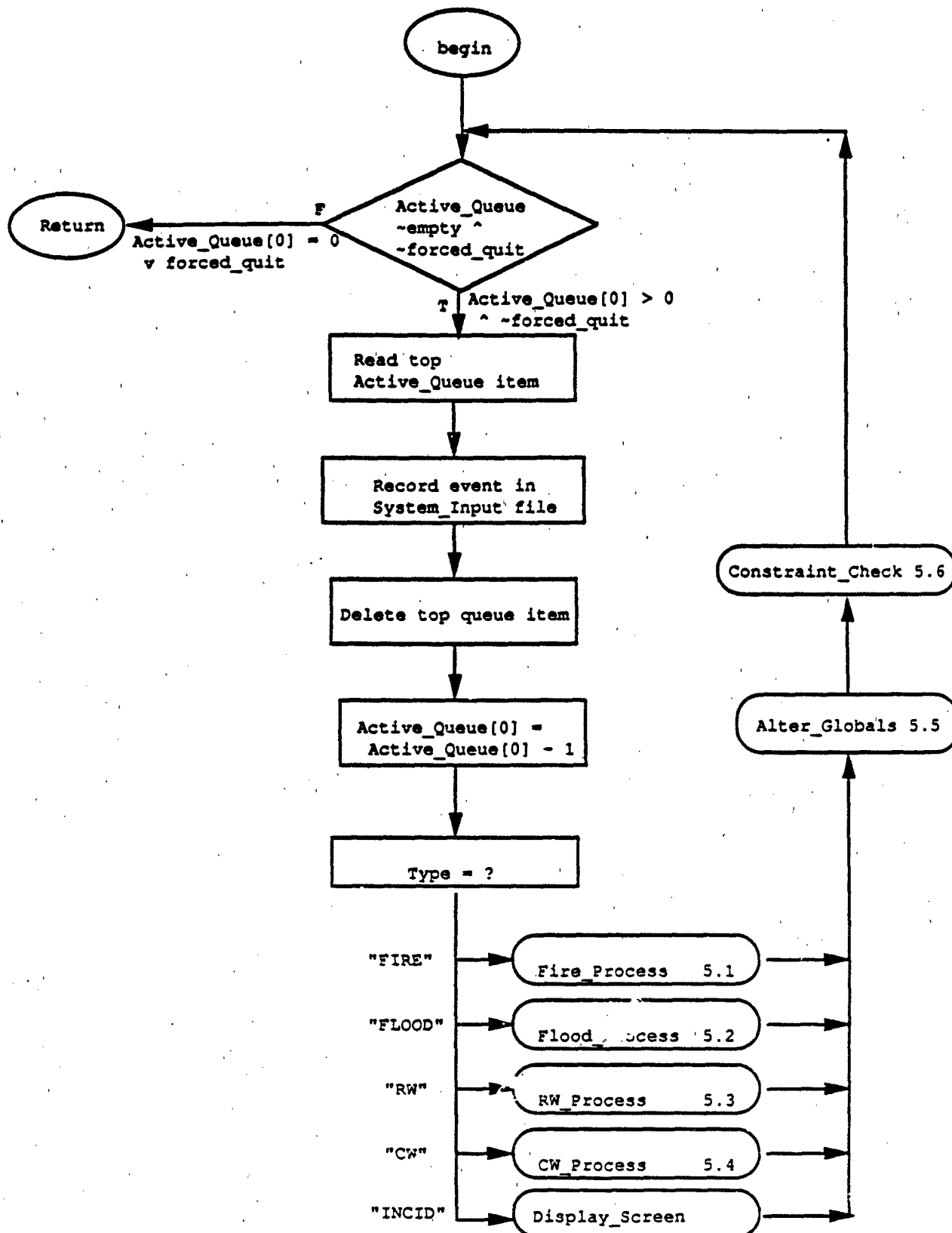


FIGURE 4.27. PROCESS\_QUEUE 5.0

will take place after the event process is complete. Then the variables will be tested to make sure that the ship's status is acceptable for continuing play. It is possible that several events will be in process simultaneously and the communication panel of one event could be continuously overwritten by communication panels of other events. To avoid such a problem of starvation (i.e., the background event could time-out or expire before it is ever activated), a dedicated key will be provided to the user to select any of the communication panels attempting to be displayed. Also, if an event has been ignored for too long, the system will present a message to remind and prompt the user that the other messages exist in the queue and must be responded to within the appropriate time.

#### 4.3.7.1 5.1 Fire\_Process

TBD.

The static decision tree process will be expanded as part of the final design prior to coding, in the manner discussed in Section 4.6.

#### 4.3.7.2 5.2 Flood\_Process

TBD.

The static decision tree process will be expanded as part of the final design prior to coding, in the manner discussed in Section 4.6.

#### 4.3.7.3 5.3 RW\_Process

TBD.

The static decision tree process will be expanded as part of the final design prior to coding, in the manner discussed in Section 4.6.

#### 4.3.7.4 5.4 CW\_Process

TBD.

The static decision tree process will be expanded as part of the final design prior to coding, in the manner discussed in Section 4.6.

#### **4.3.7.5 5.5 Alter\_Globals**

TBD.

The purpose of this module is to manage the world parameters such as water pressure, repair party size, etc., in the manner discussed in Section 4.3.3.1.

#### **4.3.7.6 5.6 Constraint\_Check**

TBD.

The purpose of this module is to check the current status of the world to determine if play can continue. Examples of proposed constraints and contingencies are presented in Table 4.5.

#### **4.3.8 6.0 End Session**

The purpose of the End-Session module (Reference Figure 4.28) is to read the User\_Input and System\_Input files, which have entries that are time-ordered, and merge them for display to the user. The entry will either trigger a specific to-be-determined script to be presented to the user, or the entry will express the user's actions. The script will advise the student of issues that should be considered given the situations that were previously encountered.

TABLE 4.5. DECAID SCENARIO PRESENTATION SYSTEM - EVENT CONSTRAINTS

---

**FIRE CONSTRAINT**

If Fire advances 100 feet from point of origin, the ship is lost.

**FLOODING CONSTRAINT**

If progressive Flooding has not been stabilized after 15 minutes, the ship is lost.

**CHEMICAL WARFARE CONSTRAINT**

Any Personnel on deck at the time of the attack, in MOPP III or less, are dead.

50% of personnel below decks, in MOPP III or less are dead.

**RADIOLOGICAL WARFARE CONSTRAINT**

If the Water Washdown system is "ON" when fallout begins, contamination levels are reduced by a factor of 0.4.

**FIREMAIN CONSTRAINT**

All Firepumps must be on-line for Water Washdown to operate.

---



#### 4.4 EXPANSION OF THE DETAILED DESIGN FOR THE INITIALIZATION MODULE - "1.2 FIRE\_SETUP"

##### 4.4.1 Overview

##### 4.4.2 1.2 Fire\_Setup (in greater detail)

The purpose of this detailed flowchart (Reference Figure 4.29) and explanation is to provide an example of the level of depth that all the flowcharts need to be taken to before programming commences. A primary consideration is deciding on the various data structures that will be used in the final specification and coding of the software modules. For example, the structure for the fire bits read in is assumed for this flowchart to be:

```
typedef struct
{
    struct time_format Real_Time;
    struct time_format Scenario_Time;
    unsigned Location :4;
    unsigned Class :2;
    unsigned Rate :3;
} fire_format
```

Therefore, we also need:

```
typedef struct
{
    integer hour;
    integer minute;
    integer second;
} time_format
```

The Fire\_Setup increments the counter that keeps track of the number of records on the Fire\_Queue. The bits that were read in from the file are then placed in the fire\_format. The real\_time and the scenario\_time are read over to the fire\_queue. As the location, class, and rate are decoded (converted from binary to a meaningful representation), they are added to the record in the fire\_queue. Also the appropriate screens and icons that represent a fire in this area are read from secondary memory to primary memory for quick access. The procedure will then return to 1.0 Initialize.

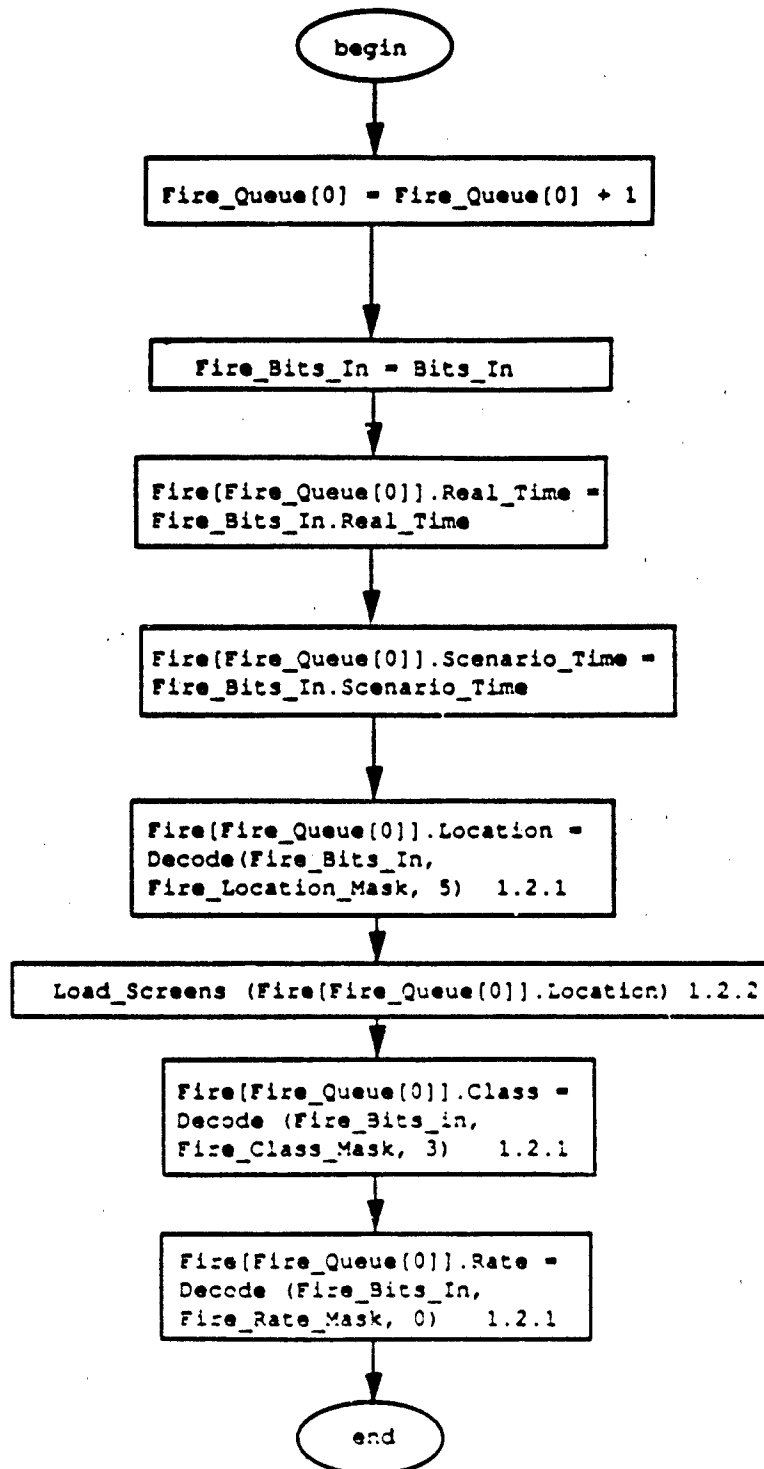


FIGURE 4.29. FIRE\_SETUP 1.2  
(In greater detail)

#### 4.4.2.1 1.2.1 Decode(Rec\_In, Mask, Shift) = integer

The purpose of the Decode function (Reference Figure 4.30) is to accept a string of bits, apply the appropriate mask, shift the bits, and return the equivalent decimal digit.

The purpose of a mask is to make the bits that are not of interest become zeroes, and allow bits of interest to retain their values. In this example, the mask values are:

```
Fire_Location_Mask = 111100000
Fire_Class_Mask    = 000011000
Fire_Rate_Mask     = 000000111.
```

For example, assume Rec\_In = 010111001, and the item we are interested in is the class. Then "AND" Rec\_In with Fire\_Class\_Mask,  $010111001 \wedge 000011000 = 000010000$ .

The next step is to shift the bits right. In the case of finding the class, Shift = 3. Therefore, the value just attained is shifted right by three.  $(000010000 \gg 3 = 10)$

This value (10) is the machine representation of the number two. Earlier in the program, the programmer should have defined a value to be associated with each class. For this example assume that the value two is defined to be class C. Therefore, by returning 10 (2), this fire will be class C.

#### 4.4.2.2 1.2.2 Load\_Screens (Location)

The purpose of the Load\_Screens procedure (Reference Figure 4.31) is to bring from the hard disk to RAM memory the appropriate screens that are associated with the event type and the location. In this example, this is accomplished by concatenating the string "Fire\_" and the location string (as defined by a specific Ship Plate). The resulting value is then used in conjunction with a routine call to the Prototyping or Authoring system software. For example, the routine could call a function "Windows", where

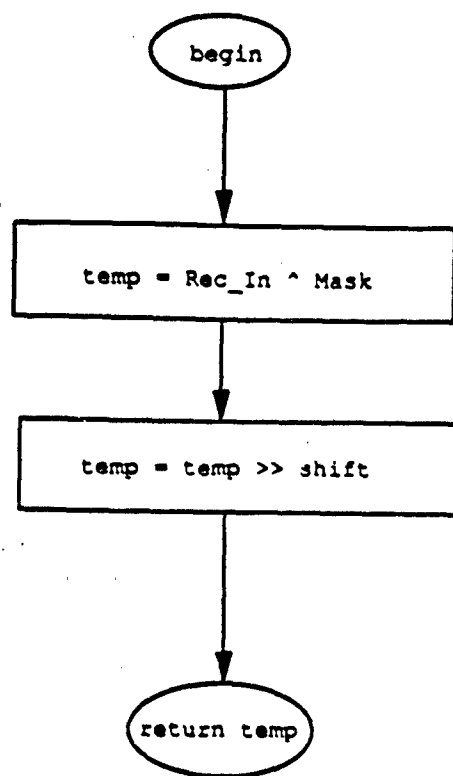


FIGURE 4.30. DECODE (REC\_IN, MASK, SHIFT) = INTEGER 1.2.1

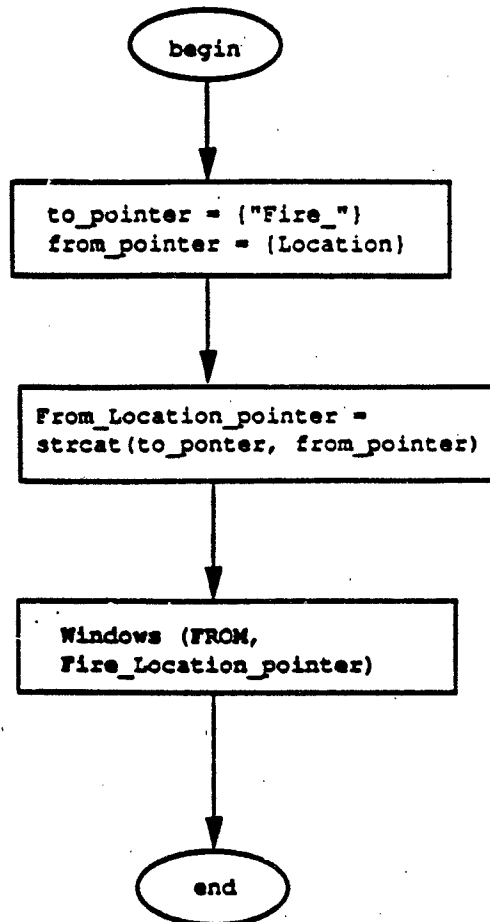


FIGURE 4.31. LOAD\_SCREEN (LOCATION) 1.2.2

"Windows" is a routine, provided by the Prototyping software "Skylights", which is used specifically for bringing in bitmaps and catalogues of bitmaps.

#### 4.5 QUEUE\_CHECK/PROCESS\_QUEUE ALGORITHMS

##### 4.5.1 Overview

##### 4.5.2 Overview of Queue\_Check (4.0) and Process\_Queue (5.0)

A diagram (Reference Figure 4.32) is presented to aid in depicting the system view of the queue management by both Queue\_Check and Process\_Queue. The flow of information, after initialization, is as follows:

1. Queue\_Check checks each of the queues to determine which of the entries need to be activated.
2. The activated entries are placed on the Active\_Queue.
3. Process\_Queue removes the entries and invokes the appropriate process with the information from the Active\_Queue as parameters.
4. The various processes update the global variables and provide the forward motion through the decision tree. As needed, they will place the next timed decision on its queue for later presentation.

At this point, step one is activated.

Figure 4.33 shows the Queue Format for "Fire\_Queue". The Queue Format is in the form of a table that includes:

- Number of items in the Queue
- Event type
- Real-time offset
- Scenario event time
- Remaining parameters (in the Queue).

The Queue entry with the index of "0" will always show the number of items in the Queue.

# OVERVIEW OF QUEUE\_CHECK AND PROCESS\_QUEUE

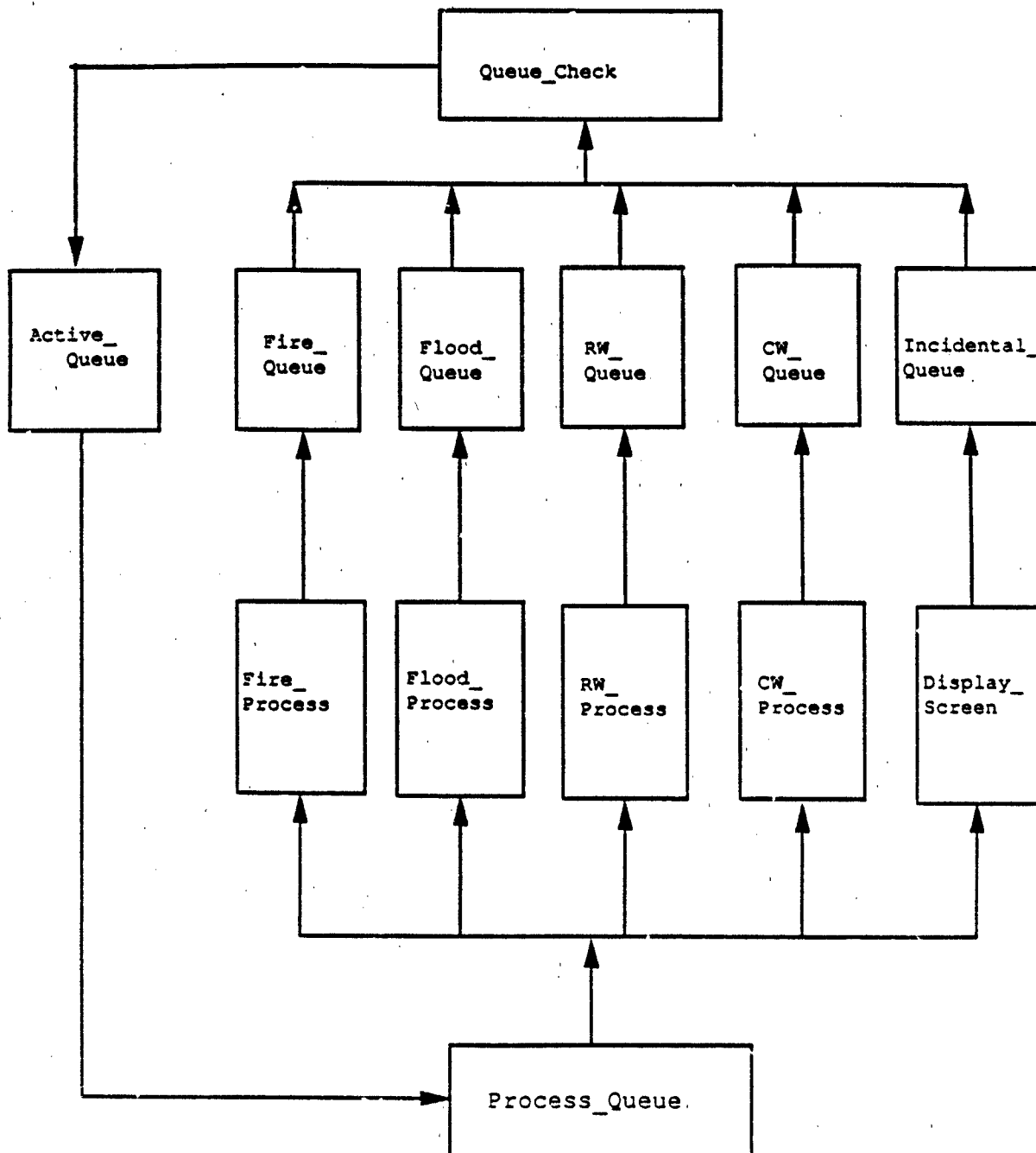




FIGURE 4.32. OVERVIEW OF QUEUE\_CHECK AND PROCESS\_QUEUE

# Queue Format

Fire Queue

|       |      |       |      |                         |
|-------|------|-------|------|-------------------------|
| Index |      |       |      |                         |
| 0     | 2    |       |      |                         |
| 1     | FIRE | 03:38 | 2:30 | remaining parameters... |
| 2     | FIRE | 04:18 | 3:15 | remaining parameters... |
| 3     |      |       |      |                         |
|       |      |       |      |                         |
|       |      |       |      |                         |
| n     |      |       |      |                         |

  
 Event  
type

  
 Elapsed Time


  
 Scenario event time

FIGURE 4.33. QUEUE FORMAT



The elapsed time is the number generated by the "Matrix\_Maker" according to the random number generator seed and the time range indicated by the instructor. The format is minutes and seconds (mm:ss), with respect to scenario start, and represents the time from the onset of the scenario that the occurrence of the event should take place. This number is converted by Queue-Check to determine the running time for each session or problem.

The Scenario event time is shipboard clock time for an event, i.e., the time it would actually take to complete a damage control activity. The format is hours and minutes (hh:mm), and represents the time from the onset of the scenario start that the occurrence could take place on the ship. As stated above, it is representative of the time that would have lapsed in a real on-going damage control event. All "real times" are represented in the scenario by some constant multiplier that allows for "fast time" simulation. For example, four crew members are told to go to a fire location. In "real" time, it may take a crew 10 minutes to travel from their current location to the fire location; this travel, however, may take only 1 second in the scenario. This fast time transformation allows DECAID to emphasize DCA decision tasks and their potential outcomes, while eliminating "dead time" which would be required to accomplish damage control tasks aboard ship.

#### 4.5.2.1 Algorithm of Queue\_Check

The following algorithm considers each queue entry as a record that will have real time as one of its fields. This field will contain the offset from the scenario start time to indicate when an event should occur. The index of zero of each queue is reserved as a counter of the number of entries currently contained within the queue. Current\_next is a variable used as an index into Active\_Queue such that queue entries do not get overwritten. Push\_Up (queue) is a procedure described below. Other variables include i, b, c, and flag.

```

get current_time
current_next = 0
for each queue do
    run_time = start_time + queue[1].time
  
```

```

while (run_time <= current_time) and (queue[0] > 0) do
    current_next := current_next + 1
    Active_Queue[current_next] := queue[1]
    Push Up (queue)
endwhile
endfor

Active_Queue[0] := current_next

repeat
    flag := false
    b = 0
    c = 1
    for i = 0 to (current_next - 1) do
        if Active_Queue[b].time > Active_Queue[c].time then
            temp := Active_Queue[b]
            Active_Queue[b] := Active_Queue[c]
            Active_Queue[c] := temp
            flag := true
        endif
        b := b + 1
        c := c + 1
    endfor
until flag = false

```

Push\_Up (queue) is a routine that moves all the entries of the queue up one place. Since each queue maintains a "pointer" to its last filled entry, the algorithm for Push\_Up is:

```

if queue[0] > 0 then
    for i = 2 to queue[0] do
        queue[i - 1] := queue[i]
    endfor
endif
queue[0] := queue[0] - 1.

```

## 4.6 THE DECISION TREE CONCEPT

### 4.6.1 Decision Tree

A decision tree (see Figure 4.34) is a technique used to define and document the possible options associated with a given situation. It makes the event easy to conceptualize for the non-technical users. Each event will be associated with a static decision tree. The current position within the tree

# DECISION TREE

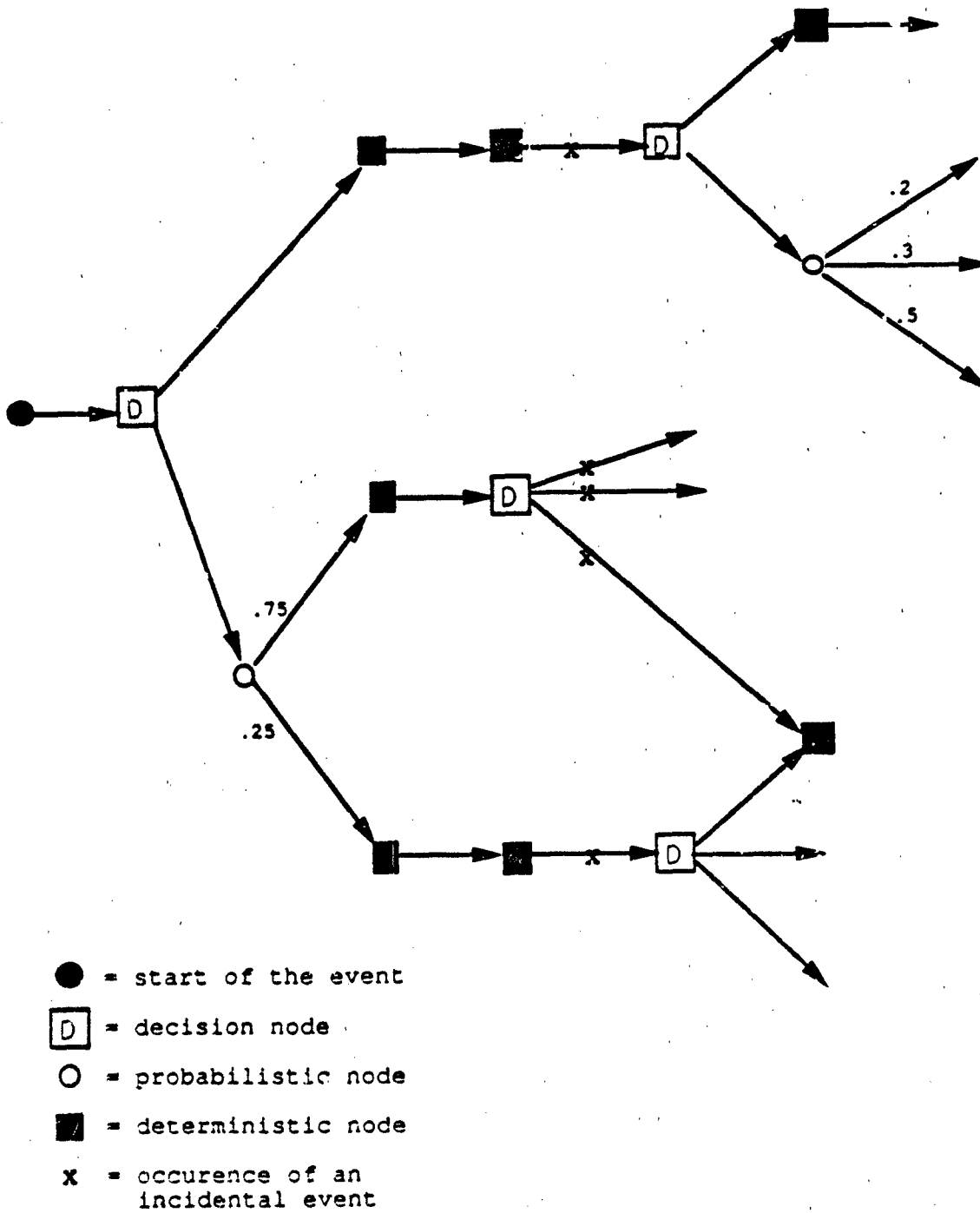


FIGURE 4.34. DECISION TREE EXAMPLE

is dependent on the previous decisions made by the user, as well as the random number generator. The decision tree needs to be static so the situation has bounds, and thereby is kept tractable. Traversing through an event requires the user to cover different types of nodes in the decision tree such as Decision nodes, Probabilistic nodes, and Deterministic nodes.

**Decision nodes** require a response of the user in the basic "yes/no" form or the basic "choose-one-of-the-above" form. The decision node aids in determining what will occur next in the event. Decisions are the nodes that the user has control over the possible exit routes from it.

**Probabilistic nodes** will be intrinsic to the system and will occur at various places along the paths of the event decision tree. A probabilistic node will read the system clock value to determine which path to take. For example, assume that route one will be taken 75% of the time and route two is chosen the remaining 25% of the time, then two digits to the right of the decimal will be used to determine which path to take. If these two digits are less than 25 then choose route two, else choose route one. So, if the time the decision was made was 4:32:54, then since 54 is not less than 25, the path chosen would be route one. The user has no control over these nodes.

**Deterministic nodes** have the quality that the degree-in(node) = degree-out(node) = 1. They are parts of the event that the user will be asked for information, or told information, but the process will continue along the same path.

Another item that is part of the decision tree, but is not static is the occurrence of incidental tasks. Incidentals will occur randomly within a range specified by the instructor, and are meant to create a natural distraction from the problem at hand. The time of onset will be static regardless of which branch of the decision tree that the user has traversed, and there will be a limit of five incidentals per event.

The user must be wary of information provided through communications because the instructor can request that a certain amount of the communications contain false information. This is beneficial because it provides a more realistic scenario, having the players making mistakes as real people sometimes do.

APPENDIX 4.0 A

EXAMPLE OF A DECAID SCENARIO, INCLUDING EVENTS,  
ONGOING DECISION IMPACTS AND CONTINGENCIES

**EVENT 1:**

**Processes/Decisions:** Introduction and Background

**Input:** Housekeeping screen (ID, Date, etc.), Title, Scenario objectives, Background material on scenario, e.g.,

"You are DCA aboard an FFG steaming in the North Arabian Sea, enroute to the Persian Gulf. The ship's mission is to rendezvous with a convoy of six reflagged Kuwaiti tankers and, along with two other warships, escort them to Kuwait and back out to the North Arabian Sea. U.S. intelligence has identified several Silkworm missile sites and speedboat bases within range of your proposed track. Intelligence reports also indicate that chemical warheads of Iranian manufacture have been transported to Silkworm sites.

"The convoy has just passed through the straits of Hormuz. Intelligence reports that Iraq has just used "dusty mustard" to repel an Iranian ground attack near Abadan. There is a high likelihood that Iran will retaliate with a demonstration of its newly improved CW capability within the next 48 hours. The average daytime air temperature is 97°F with an injection temperature of 86°F. General Quarters have been called and materiel condition ZEBRA has been set. The convoy commander has ordered complete radio silence, so all communication will be visual."

**Output:** Move to next screens.

**Contingencies:** Start of play commences after review of this material.

**EVENT 2:**

**Processes/Decisions:** Decision on weather favorability for CW attack.

**Input:** MET report from Bridge and request for assessment of favorability of CW attack against ship.

**Output:** Favorability assessment in terms 'Very Unfavorable' to 'Very Favorable.'

**Contingencies:** None within DECAID program. Assessment will presumably color user's subsequent decisions and actions to some extent.

**EVENT 3:**

**Processes/Decisions:** Decide on MOPP in light of level of threat, impact on shipboard operations, crew well-being, etc., and prioritization among same.

**Input:** Message from Bridge, e.g.,  
"DCA, what is recommended MOPP level?"

**Output:** Decision to recommend MOPP I, II, III, or IV.

**Contingencies:** On the negative side, higher MOPP level implies (a) greater heat stress hazard and (b) more time needed to complete shipboard tasks. On positive side, there will be fewer chemical casualties in the event of CW attack.

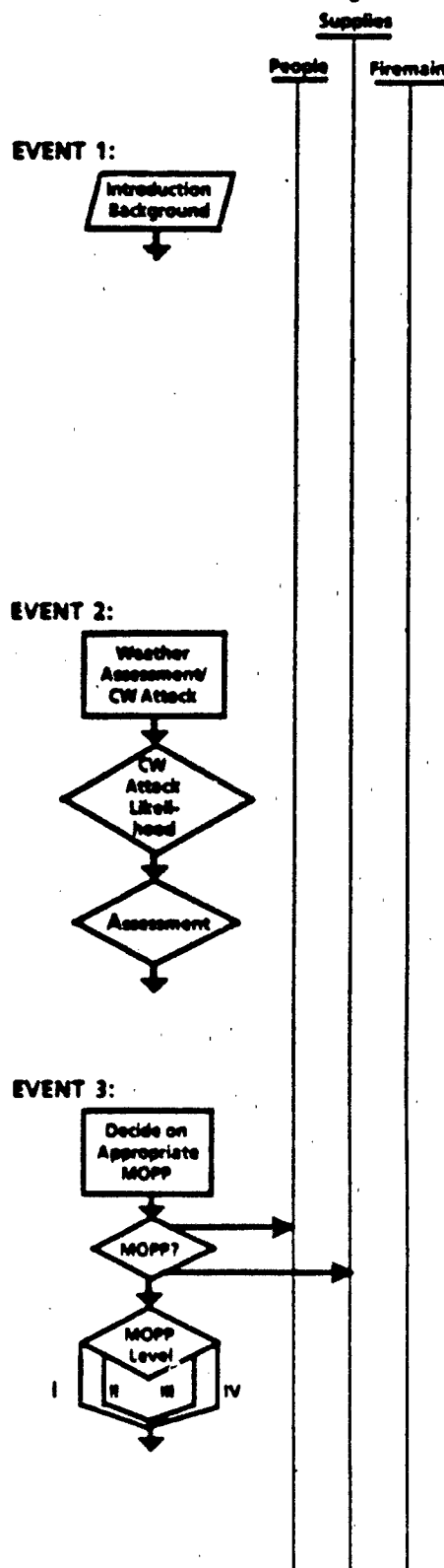
For heat stress, a system clock will track time in MOPP. After preset durations of "scenario time," the system will induce some number of Combat Ineffectives (CI) due to heat stress. Different heat stress attrition rates will be imposed for different MOPP levels.

A task time multiplier will be paired with each MOPP level to induce different degrees of task time increase due to the encumbrance of MOPP level. For critical shipboard tasks (e.g., rigging shoring), baseline completion times will be increased by the task time multiplier.

Five (5) minutes of scenario time will pass before a message returns that personnel are at, e.g., MOPP 4 if that was what was indicated.

If recommended MOPP is I or II, skip EVENT 4.

## Ongoing Decision Impacts and Contingencies



**EVENT 4:**

Processes/Decisions: Water Wash-Down (WWD)/Firemain Management Decision

Input: Should WWD system be activated?

Output: User decides "Yes, turn it on" or "No, do not turn on."

Contingencies: If WWD system is on, this will save Z crew members in the event of CW Attack.

If WWD system is on, this will increase time to complete topside evolutions (e.g., rig P-250 pump, reload topside weapons such as the CWS).

If WWD system is on, Firemain pressure drops and Chief Engineer directs the DCA to restore Firemain pressure because sufficient chill water isn't reaching (e.g.) CIC. This is itself a decision which the DCA must make on how to meet the Chief Engineer's needs.

(All fire pumps need to be on the line to support use of WWD. If user turns all pumps on to keep pressure up, a selected pump will fail due to overheating in 8-10 minutes of scenario time.

If user turns WWD off, ship will lose Z crew members in the event of an attack.

**EVENT 5:**

Processes/Decisions: Decision on best/acceptable route.

Input: Request for a route for crew member from compartment x to compartment y.

Output: Ordered list of compartment numbers for approved route.

Contingencies: None directly within DECAID program. However, it will engage user who may then be interrupted by a more critical event in the scenario.

**EVENT 6:**

Processes/Decisions: Flooding casualty risk management.

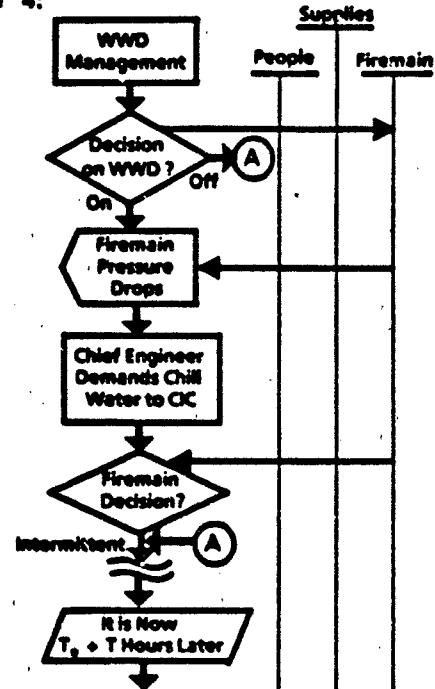
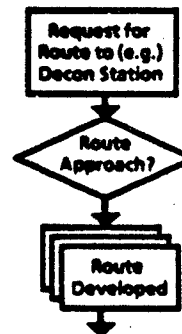
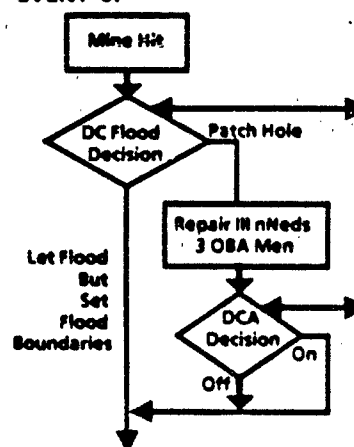
Input: Report of mine hit and flooding in particular compartment. Repair party asks DCA for direction on whether to plug hole or to set flooding boundaries and let compartment flood.

Output: User decides either to (a) patch hole or (b) set flood boundaries and let compartment flood.

Contingencies: If user decides to send patching team to plug hole, then, depending on MOPP setting in effect, heat stress may begin to build, tasks take extra time to complete. Patching operation uses Repair III people and crew time to complete. On-scene repair party leader requests for three additional men. User must decide whether or not to allocate the additional men. If user decides to honor request for more men, then these will be taken from another repair party and will be unavailable for other duty. If user does not honor request for more men, then probability exists that task will take too long, compartment will be flooded anyway, pump will short out, some Repair III men will drown.

Setting fire boundaries implies that ship loses that compartment and flooding will cause a fire pump to short out (scenario designer must pick a space which has a fire pump in it). On the other hand, this option involves less crew members and is faster to carry out than plugging the hole. Will not consider impact on stability and buoyancy in this scenario, but could be included in a later version.

### Ongoing Decision Impacts and Contingencies

**EVENT 4:****EVENT 5:****EVENT 6:**

Ongoing Decision Impacts  
and Contingencies

## EVENT 7:

Processes/Decisions: Management of fire fighting operations. Repair II assigned to fire fighting. User must decide on:

- Permission to assign more men in O&A gear (From Repair II) to fight fire
- Permission to relax MOPP to fight fire
- Approve or disapprove recommendation to rig P-250 pump topside for fire-fighting water.

Input: Report of fire in electrical shop (caused by mine hit).

Output: 'Yes' or 'No' to above decision questions.

Contingencies: With respect to Firemain Management,

If WWD was used earlier, pump may have been lost.  
If flood boundaries were set or flooding progressed because too few people at too high a MOPP level were assigned, another pump will have been lost.  
If both pumps were lost, WWD system will not work.  
If pump lost, P-250 pump will be needed.  
If WWD system is still on, will slow down rigging of P-250 pump.  
If fire fighting water not above a minimum acceptable threshold, Repair II will report "DCA, Repair II retreating from fire due to insufficient fire pressure at nozzle." Fire will progress.

## EVENT 8:

Procedures/Decisions: Decide on best response to CW attack. Set MOPP level, turn on WWD.

Input: Ship hit with Silkworm missile loaded with Chemical Ordnance.

Output: MOPP level recommended, WWD system on or off

- (Do we wish to include aspects of the CBR Bill, e.g., allow/require user to set up decontamination station, post detector paper, set Circle William, etc.)?

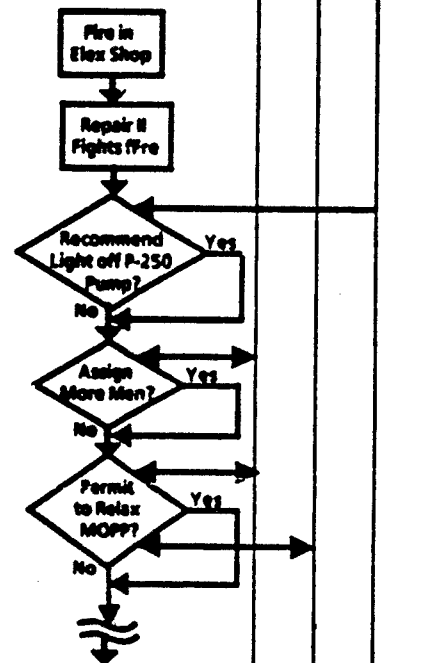
Contingencies: As relevant, personnel on deck (working P-250 pump) die if MOPP level is I or II. If MOPP level is III, one out of three die. If level is IV, no one topside is lost.

It takes 5 minutes of scenario time for personnel to get from MOPP I or II to MOPP 4. It takes 30 seconds to go from MOPP III to MOPP IV. Combat ineffectives who are chemical casualties will be a function of MOPP level, time.

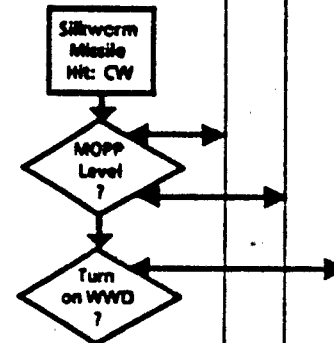
WWD will not work if two pumps down.

If pump failed from using WWD earlier, it may have recovered by this point.

## EVENT 7:



## EVENT 8:





## Ongoing Decision Impacts and Contingencies

## EVENT 9:

**Procedures/Decisions:** Decision on whether and how to restore Firemain.

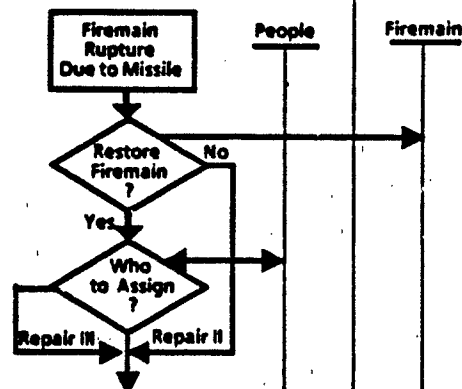
**Input:** Report of ruptured Firemain due to impact of silkorm missile.

**Output:** Assign Repair 3 to restore Firemain.  
Assign Repair 2 to restore Firemain.  
Do not assign anyone to restore Firemain.

**Contingencies:** If Repair 2 goes to restore Firemain, fire in electrical room goes out of control immediately because of lack of fire fighters.

If no one is assigned to Firemain, fire quickly goes out of control because of lack of water.

## Event 9:



## EVENT 10:

**Procedures/Decisions:** Risk management

**Input:** CO requests decon of CIWS

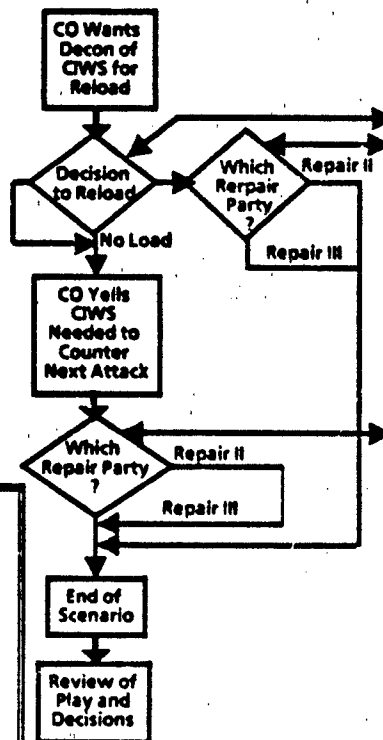
**Output:** Take decon team from Repair II  
Task decon team from Repair III  
Tell CO no personnel available to decon CIWS

**Contingencies:** If Repair II is used, fire goes out of control from lack of fire fighters.

If Repair III is used, Firemain rupture not fixed, fire gradually goes out of control.

If tell CO no, CO yells that CIWS kept the Silkorm from a direct hit, and is needed to counter next missile attack.

## EVENT 10:



## Important Points:

Wherever the word "will" is used in these notes, it should be interpreted as provisional only.

Wherever the word "user" is used in these notes, it should be interpreted to mean the Student DCA.

It is assumed that the user will have available for display a status board or "score sheet" which includes current levels of various measures of merit such as Number of Combat Ineffectives, Extent of Damage, Number of crew members available for Damage Control duty, and so forth.

APPENDIX 4.0 B

DECAID SCENARIO PRESENTATION SYSTEM DATA BASE OF  
SETUP PARAMETERS (TO BE USED IN SPECIFYING THE  
INITIAL CONDITIONS MATRIX), AND SCORE KEEPER PARAMETERS

This Data Base is representative of the types of data and information that needs to be available to the instructor to define the Scenario Generation Parameter values.

## DATABASE FOR BACKGROUND/SET-UP PARAMETERS

## 1.0 Environment (Internal)

## 1.1 Climate

1.1.1 Temperature (60-90 deg.F/5 deg. inc.; Def = 75 deg)

1.1.2 Humidity (60-90%; Def = 75%)

## 1.2 Atmospheric Quality

1.2.1 Smoke (0-100%; Def = 0%)

1.2.2 Toxic Gases (Mg/M3/Min; range TBD; Def = TBD)

## 2.0 Environment (External)

## 2.1 Climate

2.1.1 Temperature (20-105 deg. F/5 deg inc.; Def = 75 deg)

2.1.2 Relative Humidity (0-100%; Def = 75%)

2.1.3 Precipitation (None, Light, Medium, Heavy; Def = None)

2.1.4 Wind Speed (0-45 knots; Def = 0 knots)

2.1.5 Cloud Coverage (0-100%; Def = 0)

2.2 Sea State (0, 1, 2, 3, 4; Def = 1)

2.3 Visibility (0-100 miles; Def = 20 miles)

## 3.0 Alert Status

3.1 Readiness Condition (I, III, IV; Def = III)

3.2 Material Condition (Yoke, Zebra, Circle W; Def = Yoke)

3.3 MOPP Level (0, I, II, III, IV; Def = I)

3.4 Threat Condition (None, Yellow, Red; Def = None)

## 4.0 Material Status (units and ranges TBD)

4.1 Draft Fore and Aft

4.2 Liquid Load

4.3 List and Trim

4.4 Compartments Damaged/Flooded due to Previous Attacks

4.5 Fire Pumps Out of Commission or Operating at Reduced Capacity

4.6 Vital Equipment Currently Using Firemain for Cooling

4.7 Major Damage Control Equipment/Systems Out of Commission

## 5.0 Logistics Inventory Status (Range: 0-100%/10% inc.; Def = 100%)

5.1 Gas Mask Canisters

5.2 OBA Canisters

5.3 Sets of Unopened Protective Clothing

5.4 Spare CO2 Bottles

5.5 Drums of Spare Aqueous Film Forming Foam (AFFF)

5.6 Spare Halon Bottles

5.7 Calcium Hypochlorite Bottles (Decon Solution)

5.8 Booklets of M8 Paper

5.9 M258 Kits

5.10 M256 Kits

5.11 Gasoline for P-250 Pumps

## 6.0 Personnel Status

6.1 Training Level of Repair Lockers (High, Medium, Low; Def = Medium)

- Fire
- Flooding
- CBR-D

- 6.2 Training Level of Key Individuals (High, Medium, Low; Def = Medium)
- Repair 2 Leader
  - Repair 3 Leader
  - Scene Leaders
- 6.3 Repair Locker Manning Level (50-110%, 5% inc.; Def = 95%)
- 6.4 Casualties to Key Personnel (Def = none)
- Repair 2 Leader
  - Repair 3 Leader
  - Scene Leader
  - #1 OBA Man in Repair 2
  - #1 OBA Man in Repair 3
- 6.5 Level of Fatigue/Heat Stress (High, Medium, Low; Def = Low)
- 6.6 Prior Exposure to Agents
- Radiation (0-150 rads/25 rad inc.; Def = 0)
  - Chemical Agents (High, Medium, Low, None; Def = None)

## DATABASE FOR SCENARIO GENERATION

## 1.0 Displays

## 1.1 Ship Plates (Video/Drawings)

## 1.1.1 Movement

## 1.1.1.1 Scrolling Direction

- Continuous Horizontal: Same Deck, Across Compartments
- Continuous Vertical: Across Decks, Same Compartment
- Continuous Diagonal: Across Decks, Across Compartments
- Discontinuous Horizontal: Same Deck, Discrete Jumps to Compartments
- Discontinuous Vertical: Discrete Jumps to Decks, Same Compartment
- Discontinuous Diagonal: Discrete Jumps to Decks, Compartments

## 1.1.1.2 Scrolling Rate

- Fine Movement: Scroll across existing display (1/32; 1/16; 1/4; 1/2 of Screen)
- X-Y Movement Within Compartment, with mouse or arrow keys
- Gross Movement: Between Screens (e.g. decks or sections)

## 1.1.2 Overlays

- Firemain
- Ventilation
- Electrical Distribution
- Plumbing/Drainage
- Water Washdown System
- Fuel Transfer
- Closure Log

## 1.2 Icons

## 1.2.1 Damage Symbology

- Fire
- Smoke
- Flood
- Chemical Agent
- Nuclear
- Firemain Rupture

## 1.2.2 DCA Central

- Communications Boxes
- Firemain Control System
- Clinometer

## 1.2.3 Closures

- Classification
- Status (Secured, Unsecured)

## 1.2.4 Ship Locator Icon

## 1.3 Databases

## 1.3.1 Drawings

## 1.3.2 Blueprints

## 1.3.3 Graphics Files

## 1.4 Touch Sensitive Zones

## 1.4.1 Mechanism for Activating Touch Zone

- Pen
- Mouse
- Touch Screen
- 1.4.2 Location of Touch Sensitive Zones
  - Compartments
  - Arrow Keys for Scrolling
  - Communications Windows
  - Pull-Down Menus
- 1.4.3 Resolution of Touch Zones
  - Coarse (Character-Size Zones)
  - Fine (Pixel-Size Zones)
- 1.5 Graphics
  - 1.5.1 Color
    - Added Depth Perception
    - Color Coding of Structures, Zones, etc.
  - 1.5.2 Texture
    - Added Depth Perception
    - Texture Coding of Structures, Zones, etc.
  - 1.5.3 Animation
- 2.0 Threat Characteristics:
  - 2.1 Types
    - 2.1.1 Chemical Agent
      - 2.1.1.1 Type (VX, HD, GA, GB, Blood, Choking; Def = VX)
      - 2.1.1.2 Point of Initial Detection
      - 2.1.1.3 Rate of Spread (10-50 ft/min; Def = 20)
      - 2.1.1.4 Location of "Hot Spots"
    - 2.1.2 Nuclear Agent
      - 2.1.2.1 Time and Intensity of Fallout Arrival (T1-T10 min; Def = T3)
      - 2.1.2.2 Time and Level of Peak Intensity (Time: T5-T15 min; Def = T8. Intensity: 100-1500 rad/hr; Def = 1000)
      - 2.1.2.3 Time and Level of Fallout Cessation (Time: T10-T30 min; Def = T20. Intensity: 25-100 rad/hr; Def = 50)
      - 2.1.2.4 Decay Rate Slope (-.5 to -2.0; Def = -1.2)
      - 2.1.2.5 Location of "Hot Spots"
    - 2.1.3 Flooding
      - 2.1.3.1 Initial Location
      - 2.1.3.2 Flooding Rate (10-100 gal/min, 10 increm.; Def = 30)
      - 2.1.3.3 Cause of Flooding (Split seam, hole, ruptured sea chest; Def = hole)
    - 2.1.4 Fire
      - 2.1.4.1 Initial Location
      - 2.1.4.2 Class of Fire (A,B,C, D; Def = C)
      - 2.1.4.3 Rate of Fire Spread (1,2,3,4,5 ft/min; Def = 1)
  - 2.2 Presentation
    - Pre-existing-threat already exists when scenario begins
    - Current affair-threat presented during course of scenario
  - 2.4 Time Course

- Short-term--transient, resolved within time span of scenario
- Long-term--not fully resolved within time span of scenario

### 3.0 Incidental Events

#### 3.1 Type

- Routing Request
- Others (TBD)

#### 3.2 Duration

- Short
- Long

#### 3.3 Complexity

- Simple
- Difficult

#### 3.4 Time of Occurrence

- Between Threats
- During Threat

#### 3.5 Number of Incidental Events per Scenario

### 4.0 Players

#### 4.1 Superiors

- CO
- XO

#### 4.2 Subordinates

- Repair Locker 2 Leader
- Repair Locker 3 Leader
- Master Chief

### 5.0 Communications

#### 5.1. Types of Communications

##### 5.1.1 Input to DCA

##### 5.1.1.1 From Bridge

- Receive Information
- Receive Orders
- Receive Requests for Information and Recommendations

##### 5.1.1.2 From Repair Lockers

- Receive Information
- Receive Requests for Information and Recommendations

##### 5.1.1.3 From Chief Engineer

- Receive Information
- Receive Orders
- Receive Requests for Information and Recommendations

##### 5.1.2 Output from DCA

##### 5.1.2.1 To Bridge

- Answer Requests for Information
- Request Information
- Make Recommendations

##### 5.1.2.2 To Repair Lockers

- Answer Requests for Information
- Request Information
- Make Recommendations/Give Orders

##### 5.1.2.3 To Chief Engineer

- Answer Requests for Information

- Request Information
- Make Recommendations

## 5.2 Number and Frequency of Incoming Communications

- 5.2.1 Total Number of Communications per Scenario (Range TBD)
- 5.2.2 Average Time Between Communications (Range TBD)

## 5.3 Priority of Incoming Communications (Prioritization list: Bridge, Chief Engineer, Repair 3, Repair 2)

## 5.4 Reliability of Communications (% of communications which are reliable or accurate) (Range: 100 - 97%; Def = 98%)

# 6.0 Stores Management

## 6.1 Fire

- 6.1.1 Fire fighting suits
  - Condition
  - Life span
- 6.1.2 OBA Canisters
- 6.1.3 Drums of Spare Aqueous Film Forming Foam (AFFF)

## 6.2 CBR-D Equipment (Ranges TBD)

- 6.2.1 MOPP Suits
  - Condition
  - Life span
  - Location
- 6.2.2 Unopened Sets of Protective Clothing
- 6.2.3 Gas Mask Canisters
- 6.2.4 Calcium Hypochlorite Bottles (Decon Solution)
- 6.2.5 Booklets of M8 Paper
- 6.2.6 M258 Kits
- 6.2.7 M256 Kits

## 6.3 Miscellaneous (Ranges TBD)

- 6.3.1 Gasoline for P-250 Pumps
- 6.3.2 Spare Halon Bottles
- 6.3.3 Spare CO2 Bottles

# 7.0 Personnel Status

## 7.1 Repair Locker Manning Level (50-110%; Def = 95%)

- Repair 2
- Repair 3

## 7.2 Casualties to Key Personnel (Def = none)

- Repair 2 Leader
- Repair 3 Leader
- #1 OBA in Repair 2
- #2 OBA in Repair 3

## 7.3 Level of Fatigue/Heat Stress (High, Medium, Low; Def = Low)



## DATABASE FOR SCOREKEEPER

- 1.0 Casualties
  - 1.1 Injured
  - 1.2 Dead
- 2.0 Material
  - 2.1 Consumed
  - 2.2 Lost or Destroyed
  - 2.3 Substitutes (Substitute list TBD)
- 3.0 Damaged Compartments (List of options TBD)
  - 3.1 Repairable
    - 3.1.1 Number
    - 3.1.2 Location
    - 3.1.3 Needed Manpower to Repair
    - 3.1.4 Needed Time to Repair
    - 3.1.5 Needed Material to Repair
  - 3.2 Unrepairable
    - 3.2.1 Number
    - 3.2.2 Location
- 4.0 Damaged Equipment/Systems (List of options, ranges, units TBD)
  - 4.1 Repairable
    - 4.1.1 Number
    - 4.1.2 Type/Criticality
    - 4.1.3 Needed Manpower to Repair
    - 4.1.4 Needed Time to Repair
    - 4.1.5 Needed Material to Repair
  - 4.2 Unrepairable
    - 4.2.1 Number
    - 4.2.2 Type/Criticality
- 5.0 Firemain-Cooled Systems
  - 5.1 Type/Criticality
  - 5.2 Duration

## SECTION 5.0

5.0 SUMMARY AND RECOMMENDATIONS

## 5.1 SUMMARY

Section 4.0 of this report presents a "high level" design Specification intended to be used for the development of the DECAID Scenario Generation System. The specification has been expressed in terms of text, and graphics (flowcharts) at the level necessary to present the basic concepts involved in specifying the way in which the system is intended to be implemented. In several cases, the concepts were expanded to include pseudocode and finely detailed flowcharts. The expanded sections were included to show the level of detail that will be necessary to be done prior to the system being coded, tested and available for use by the intended audience.

The approach followed above is consistent with the DoD software life-cycle plan currently used in the development of Government procured Computer Program Configuration Items (CPCIs). Under this approach, the specification provided herein needs to be evaluated against the goals of the project, and then if found acceptable, the next phase should be pursued. Under the next phase, each of the major modules and routines would be expanded, in detail, to include all of the pseudocode and the highly detailed flowcharts, including the development of all of the dataflow diagrams, interfaces and data bases necessary to support the fine detail.

The detailed system logic to be developed for Sections 4.3.7.1 through 4.3.7.6 of the detailed design specification, is the largest share of the next effort in DECAID system development. The material to be developed will include all of the contingency rules, decision states, algorithms, data flows, data relationships and system dynamics which are required to drive a reactive DECAID scenario presentation. The contingency rules (e.g., what happens when chemical warfare casualties exceed a certain percentage of the crew) will need to be captured and represented in this phase. Furthermore, in order for the detailed system logic to be developed, design decisions will have to be made with respect to target hardware, system software, and applications-specific software. The detailed design must be structured within

the framework of the target hardware and software. In addition, in order to be able to structure the logic of the DECAID scenario presentation system, subject matter experts will need to verify the correctness and completeness of the logic prior to it being coded.

## 5.2 CONCLUSIONS AND RECOMMENDATIONS

The following material is intended to provide a brief "roadmap" on subsequent DECAID system development activities (i.e., 6.3 project efforts).

Based on the material included in this report, the following recommendations are made:

- The project should proceed to the next phase, which would result in the development and delivery of the prototype DECAID Scenario Presentation System.
- In order to accomplish the next phase of the proposed work, it will be necessary to define the target hardware, the operational software (including all of the authoring and/or prototyping software shells), and the manner in which the system will be used.
- A core set of DECAID scenarios will need to be created and validated. This core set is intended to provide the elements for instructor-tailored DCA scenarios which address specific aspects of damage control and CBR defense.
- Given a core set of scenarios, the final design phase will need to be pursued. This is seen as a creative process to interpret the detailed design specification, provided in this report, in the context of the displays, communications, input conventions, contingencies, and consequences which should evolve from the core scenarios when implemented. This creative design effort will culminate in specific software algorithms, decision logic, and programming conventions which will be documented in the final design.
- From the final design, work may be completed to program, test, and debug the DECAID system.
- After the software is operational, it may be used to run the core set of scenarios. This phase of the DECAID development effort will use the core scenarios in order to solicit inputs from fleet representatives on the correctness and completeness of the system. Based on these inputs, the system design may be

finalized and the product made available to the Surface Warfare Officer School and other users as appropriate.

- The project will be completed when appropriate user documentation is prepared. For example, a student manual may be used to present introductory and static information associated with the DECAID system in order to enhance the "You are there" element.

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GLOSSARY

|                       |   |
|-----------------------|---|
| AC:                   | Hydrogen Cyanide, a blood agent.  |
| Activated Carbon:     | Carbon which has been purified and is able to remove contamination from the air through the process of absorption.  |
| Acute Radiation Dose: | Total ionizing radiation dose received at one time and over a period so short that biological recovery cannot occur.  |
| Absorption:           | Adhesion of molecules of liquid or gas to the surface of solid materials or liquids without chemical interaction.   |
| Aerosol:              | <p>A suspension of fine liquid or solid particles in a gaseous medium, the particles being small enough to remain suspended for a significant period of time; examples of solid particulate aerosols are dusts and smoke; common liquid (droplet) aerosols are perfumes, oil mists, and fog.</p> <p>Aerosols are a potential form for all three major contaminants: chemical, biological, and radiological.</p> <p>A biological agent aerosol is defined as an airborne suspension of particles containing living pathogenic organisms.</p> |
| Aerosolization:       | The physical process of breaking up solid or liquid into fine particles and placing them in a gaseous suspension.   |
| AFFF:                 | Aqueous filming forming foam, a concentrated mixture of fluorinated surface-active agents developed for fighting Class B fires. It is a clear liquid which allows ordinary or salt water to float on the surface of hydrocarbon fuels, creating a film which prevents the escape of vapors and subsequent ignition. AFFF is applied to fuel surfaces as a foam.   |
| Air Burst:            | A nuclear weapon detonation sufficiently high in the air that the fireball does not contact the ground or water surface and thus generally produces no radioactive fallout of military significance.  |

- Air Change:** An air volume equal to a compartment volume; passage of this air through a compartment; a misleading term in that, with good mixing, only 63 percent of the air originally in a compartment is removed by one air change
- Air Lock:** A shipboard passageway with an airtight door on either end, interlocked so that both doors cannot be open at the same time, thus preventing the flow of air from one part of the ship to another.
- Alpha Radiation:** Positively charged subatomic particles emitted by radioactive contaminants (fallout). The mass and charge are equivalent to a helium nucleus. Alpha radiation is completely absorbed by a few inches of air, and by clothing.
- It is a hazard only if alpha-emitting contaminants are taken into the body by breathing, eating, drinking, or by absorption into the bloodstream through broken skin.
- AN/PDR-27 Series:** Portable radiac; dose-rate (intensity) meter; measures gamma; indicates beta on two low ranges.
- AN/PDR-43 Series:** Portable radiac; dose-rate (intensity) meter; measures gamma; indicates beta on all ranges.
- AN/PDR-56 Series:** Portable radiac; dose-rate (intensity) meter; measures alpha.
- AN/PDR-63:** Portable, modular radiac; combination dose and dose-rate meter; basic unit measures gamma; cable-connected skin dose probe measures absorbed radiation dose; attachable low-range module measures gamma and beta.
- AN/PDR-65:** Fixed shipboard or portable radiac system; combination dose and dose-rate meter; measures gamma only.
- Anthrax:** A disease caused by a type of spore-forming bacterium (*Bacillus Anthracis*) which may appear in three forms in man: cutaneous, pulmonary, and intestinal (rarely). Transmission is through scratches or abrasions of the skin, wounds, inhalation of spores, or eating improperly cooked meat. Flies can serve as mechanical vectors. The incubation period is from 1 to 7



days. Anthrax is not contagious from man to man.

The spores are very stable and may remain alive for many years in soil and water. They will resist sunlight for several days. Chlorine is effective in destroying spores.

**Atropine:**

A drug capable of partly reversing some of the effects of nerve agents.

**Bacteria:**

Single-celled, plant-like microorganisms. Many bacteria are beneficial, but some are pathogenic and could be used in biological warfare. Some bacteria produce toxins which cause disease e.g., diphtheria, tetanus, and botulism.

**Base Surge:**

The expanding surface mist resulting from a surface or underwater detonation of a nuclear weapon.

**Battle Dress:**

When General Quarters is sounded, battle dress will be promptly donned which consists of long-sleeved shirts, safety shoes, helmets, life jackets, antflash gear, and gas masks. Full battle dress may be relaxed by the commanding officer because of restrictions to movement.

**Beta Radiation/  
Beta Particle:**

A particle emitted from radioactive contaminants (fallout); mass and charge are equal in magnitude to those of an electron. Beta radiation has a range in air of only a few feet and has limiting penetrating power. The primary hazard from beta radiation is through prolonged contact with the skin, resulting in radiation burns, but beta-radiation contact hazard is not considered to be of operational significance in combat.

**Biological Agents:**

Biological agents can be placed in two classes: microorganisms (or pathogens) and toxins. The three important portals of entry into the human body are the skin, respiratory tract, and the digestive tract. Exposure of the respiratory tract to a biological agent - the most significant hazard to shipboard personnel - is accomplished by disseminating the agent as an aerosol, i.e., an airborne suspension of particles containing pathogenic organisms.

Examples of microorganisms include viruses, bacteria, and fungi. Germs can be delivered

directly (by a weapon), or indirectly, through a vector (a host carrier). Also see "Microorganisms", "Viruses", "Bacteria", "Fungi", and "Rickettsiae".

Toxins are poisonous substances produced by plants, animals, or microorganisms, but they can also be made in laboratories.

**Blister Agents:**

Chemical agents that injure the eyes and lungs and burn or blister the skin; formerly called vesicants.

**Blood Agents:**

Chemical compounds that affect bodily functions by preventing the normal transfer of oxygen from the blood to body tissues; also called cyanide agents. Blood agents are non-persistent and will remain on a target for only minutes.

**Buildup Dose:**

The topside radiological dose accrued while the intensity is rising to peak intensity; see "Decay Dose".

**Calcium Hypochlorite:**

The standard shipboard decontaminant for chemical and biological agents; four six oz. bottles of calcium hypochlorite granules mixed with five gallons of water will give a 9% solution by weight.

**Casualty:**

A person unavailable for duty because of injuries; also referred to as "Combat Ineffective".

**Catalytic Conversion:**

The chemical process by which a lethal agent is converted to a harmless substance in the presence of a third substance known as the catalyst.

**CG:**

Phosgene, a choking agent.

**cGy:**

Centigray; a unit of absorbed dose of radiation equal to a rad.

**Chemical Agent:**

Toxic chemical compound used to cause incapacitation, injury or death in humans.

**Cholinesterase:**

An enzyme which changes acetylcholine into choline and acetic acid and is important in the functioning of the nervous system.

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|-------------------------------------|--|
| <b>CIC:</b>                         | <b>Combat Information Center</b>   |
| <b>Circle William:</b>              | The shipboard material condition in which all openings between the environment and the interior of the ship, including ventilation systems, are shut.  |
| <b>CK:</b>                          | Cyanogen Chloride; a blood agent.  |
| <b>Concentration:</b>               | See "Contamination Concentration".   |
| <b>Contamination:</b>               | The deposit and/or absorption of radioactive material or biological or chemical agents on and by shipboard structures, areas, personnel, or equipment.   |
| <b>Contamination Concentration:</b> | Amount of a chemical agent vapor or aerosol present in a unit volume of air; usually expressed in milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ).   |
| <b>Contamination Control:</b>       | Procedures to avoid, reduce, remove, or render harmless, temporarily or permanently, nuclear, biological, and chemical contamination for the purpose of maintaining or enhancing the efficient conduct of military operations. |
| <b>Contamination Density:</b>       | Amount of liquid or solid agent in a unit area; usually expressed in milligrams or grams per square meter ( $\text{mg}/\text{m}^2$ or $\text{g}/\text{m}^2$ ).   |
| <b>CPS:</b>                         | Collective Protection System; a system of filters, fans and airlocks providing positively pressurized clean air to a group of spaces.  |
| <b>CS:</b>                          | The most commonly used riot control agent; causes a blinding flow of tears and involuntary closing of the eyes. In greater concentrations, it irritates moist skin and the respiratory tract. Used for training.               |
| <b>Ct:</b>                          | See "Dosage (Dose), Chemical and Biological".  |
| <b>Decay:</b>                       | The spontaneous decrease in the radioactivity of contaminant with time. The decrease is very rapid during the first few hours after burst, but slows down at later times.  |
| <b>Decay Dose:</b>                  | The topside radiological dose accrued after peak intensity; see "Buildup Dose".  |

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| <b>Decontaminant:</b>                                | Anything used to break down, neutralize, or remove a chemical, biological, or radioactive material posing a threat to personnel or equipment.  |
| <b>Decontamination:</b>                              | The process of making any person, equipment, or structure safe by absorbing, destroying, neutralizing, making harmless, or removing chemical or biological agents or by removing radioactive material clinging to it.  |
| <b>Decontamination Effectiveness (Radiological):</b> | The degree to which decontamination reduces radiation hazards; ratio of the radiation intensity after decontamination to the intensity which would have occurred at the same time if no decontamination had taken place.   |
| <b>Deep Shelter:</b>                                 | See "Shielding".   |
| <b>Density:</b>                                      | See "Contamination Density".   |
| <b>Deposit Radiation:</b>                            | Radiation from radioactive material deposited in the vicinity of the point of interest (surface contamination).  |
| <b>Detector:</b>                                     | Any mechanism by which the approach or presence of a CBR agent is made known.  |
| <b>Detector Paper:</b>                               | <p>A specially treated paper used to determine the presence of liquid chemical agent.</p> <p>The M9 detector paper is dispensed from a roll 2 inches wide and 30 feet long; it has an adhesive back and can be attached to ships' structure, equipment, or clothing; it will detect any known toxic agent, with the possible exception of mycotoxins, but has no specificity and a red color appears for all detectable agents.</p> <p>The M8 paper is used to detect liquid V, G, and H agents; issued in a book of 25 sheets; produces a variable color response depending on agent present. Since other substances (such as petroleum and insect repellent) may also cause a similar color change, M8 paper should be used only as an indicator that chemical hazards may</p> |

exist. Positive identification of the agent requires the use of the M256 detector kit.

**Detergent:**

A soap-like cleaning and emulsifying substance; in a broad sense it includes soaps, but commonly refers only to modern synthetic, non-soap detergents or surfactants which are usable in either fresh water or sea water.

**DOP Smoke:**

Diethylphthalate; an aerosol used in filter efficiency tests; particle size is predominantly in the 0.2 to 1.0 micron range.

**DOP Test:**

A test used to measure HEPA filter efficiency. DOP smoke is introduced in the air stream and the concentration before and after the test filter is measured by light-scatter techniques. DOP tests also give an indication of leakage if the percent penetration of the filter is significantly higher than the rated efficiency of the filter.

**Dosage (Dose),  
Chemical and  
Biological:**

The amount of biological or chemical agents absorbed by the body in a given period of time.

Chemical dosage (Ct) is the concentration of a chemical agent in the atmosphere (C) multiplied by time (t); expressed as mg-min/m<sup>3</sup>.

The dosage received by a person depends on how long he is exposed to the concentration; the respiratory dosage is equal to the time in minutes an individual is unmasked in an agent cloud multiplied by the concentration of the cloud; the skin dosage is equal to the time of exposure in minutes of an individual's unprotected skin multiplied by the concentration of the agent cloud.

The physiological effectiveness of aerosol dosages is influenced by particle size as well as time and concentration, since retention by the lungs and impingement on the skin are functions of particle size.

The weight of liquid agent received by a person on his skin is usually expressed as dosage in milligrams of contaminant per kilogram of body weight (mg/kg); this is equivalent to parts per million.

**Dose (Dosage),  
Radiation:**

The amount of radiation absorbed by the body, commonly expressed in rads (or cGys). Often used in the sense of the exposure dose, expressed in roentgens.

The operational criterion for friendly forces has been set at 25 rads to keep the dose low in each exposure and to allow acceptance of future exposures with the least possibility of radiation sickness; however, greater doses will be accepted as the combat situation demands; doses up to 200 rads will not cause serious symptoms of radiation sickness.

The "Penetration Dose" is that portion of the incident gamma radiation that is absorbed by internal organs of the body.

"Total Dose" is the penetration dose received from all sources, such as initial, transit, and deposit radiations, over a specified time period.

"Skin Dose" is the amount of beta radiation and that portion of the gamma radiation that are absorbed in the skin layers.

"Acute Dose" is a dose of radiation received in less than 24 hours; a "Chronic Dose" is a dose received for a long period of time; significant in the sense that an increase in the time period over which a given dose is received reduces the severity of effects.

**Dose Rate,  
Radiation:**

See "Radiation Intensity".

**Dosimeter,  
Radiac:**

Radiac instruments used to indicate the total dose received from radiation exposure; can be located at vital topside and below-decks spaces for checks on gamma exposure levels; also worn or carried by personnel to determine the total doses they have received from single or multiple exposures.

Examples of shipboard dosimeters are the DT-60/PD and the IM-143/PD Series.

**DS2:** Decontaminating Solution No.2; primary decontaminant used by the Army and the Navy ashore.

**DT-60/PD:** High-range, non-self reading radiation dosimeter; measures gamma only.

**Dust Filter:** See "Pre-Filter".

**Dynamic Test:** A test for compartment tightness which continuously supplies air at a constant rate; when a steady pressure is reached in the compartment the leak rate is equal to the rate of air supply; measurement of the supply volume and the compartment pressure defines the compartment tightness.

**Early Effects (Radiation):** Medical effects noticeable among personnel during exposure to radiation, or within hours or days after exposure (as distinguished from "Late Effects").

**Emergency Phase:** The first phase of radiological defense; associated with the time period when rapid progressive damage and contamination occur, and when countermeasures must be instituted on an emergency basis to contain damage and minimize contamination and personnel dosage (also see "Radiological Involvement").

**Fallout:** The airborne radioactive material (debris) from a nuclear burst that falls back to the surface of the earth. Fallout is a mixture of radioactive elements (Nuclear fission products) and non-radioactive material, such as sea water and bottom material as in the case of an underwater burst in shallow water, or dirt and other debris from a surface burst on land.

In this mixture, the radioactive elements are fixed to the varied-sized particles of the non-radioactive carrier material. The chemical and physical properties of the carrier particles can influence or determine the behavior of fallout, i.e., falling rate and bonding to surfaces.

Compared to initial radiation, fallout is a delayed phenomenon of the detonation, since most of it occurs minutes to hours after burst.

Surface and subsurface nuclear bursts deposit large amounts of fallout in localized areas, creating serious radiation hazards. Air bursts do not result in fallout of military significance.

Fallout contamination on weather surfaces is the major consideration in radiological recovery. This contamination will be distributed irregularly because of the action of such factors as the relative wind, the configuration of the ship, the drainage characteristics, and the condition of the surfaces.

**Final Recovery  
Phase:**

The third and last phase of radiological defense; covers detailed ship decontamination carried out in shipyards or at other support facilities (also see "Radiological Involvement").

**Fireball:**

The luminous, intensely hot mass of gas formed at the time of a nuclear detonation.

**Firemain:**

The firemain is a system of piping that receives sea water pumped from the sea chests and delivered to fireplugs and sprinkler systems. It has additional functions such as supplying water to flushing systems and cooling water to auxiliary machinery.

**Fungi:**

A form of microorganism, fungi are unicellular or multicellular members of the plant kingdom, whereas bacteria are unicellular. Fungi include molds, mildews, smuts, rusts, mushrooms, toadstools, puffballs, and yeasts. Fungi produce numerous serious plant diseases, but relatively few important diseases of man or animals are attributable to this group of organisms. Fungi have military potential primarily as antiplant agents or as a source for mycotoxins.

The cells of most fungi are larger than bacteria, ranging from 3 to 50 microns in size.

**G Agent:**

A highly toxic organophosphorus compound with anticholinesterase action; GB, GD, and GA are the common members of the group

**Gamma Radiation:**

A type of electromagnetic radiation, similar to x-rays, emitted as part of the "Initial



Radiation" and by radioactive contaminants (fallout). Usually measured in terms of the roentgen unit (r).

Gamma rays are the primary radiation hazard for shipboard personnel. Gamma radiation has an effective range in air of many hundreds of feet and is highly penetrating.

**Germs:**

Disease producing microorganisms (also called pathogens), including bacteria, rickettsiae, viruses, and fungi (See "Biological Agents" and "Microorganisms"). Slang.

**Ground Zero:**

The point of detonation of a surface burst; the point on the surface directly below an air burst; the point on the surface directly above a sub-surface burst. For a burst at sea, the term Surface Zero (SZ) is used.

**Half Thickness:**

Thickness of shielding material necessary to reduce the intensity of gamma radiation that passes through it to one half its original value.

**HD:**

Distilled mustard; the only common member of the sulfur mustard group.

**Heat Casualty:**

An individual unable to perform his duties as a result of heat exhaustion or heat stroke.

**Heat Exhaustion:**

A physical condition caused by exposure to high temperature combined with physical exertion, and marked by faintness, nausea, and profuse sweating; can be considerably reduced by proper physical conditioning and increased fluid intake.

**Heat Stress:**

Heat stress is a pathological condition in which the body's cooling mechanisms are unable to dissipate the heat load generated. It is disabling and in early, mild stages causes mental confusion and loss of coordination and concentration. Heat stress rapidly progresses through heat exhaustion to heat stroke, which is a very serious medical emergency.

**Heat Stroke:**

A state of collapse or prostration, usually accompanied by high fever, brought on by exposure to heat; has a 50% mortality rate but accounts for only a small percentage of heat casualties.

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|---------------------------|--|
| Heel:                     | A temporary or semipermanent inclination of the ship, generally involving motion.  |
| HEPA Filter:              | A High Efficiency Particulate Air filter. HEPA filters retain particles of 0.03 to 0.5 micron size with an efficiency of 99.996 percent.   |
| Hot Spot:                 | A local area of a ship where chemical or biological contamination, or the intensity of the radiation field, is considerably above the average of the surrounding area.   |
| HTH:                      | High Test Hypochlorite; a high test calcium hypochlorite product used for shipboard decontamination; available commercially as a water-soluble material.   |
| Hydrolysis:               | The splitting of a chemical compound by reaction with water; a major decontamination reaction; often accelerated by acid or alkaline solutions and by the presence of hypochlorite.  |
| IM-143/PD Series:         | High-range, self-reading pocket dosimeter; measures gamma only.  |
| Induced Radioactivity:    | Radioactivity produced in non-radioactive elements by neutrons due to the proximity of these elements to a nuclear detonation. Induced radiation occurs around ground zero. It cannot be produced in ships' structures by fallout. |
| Initial Radiation:        | Ionizing radiation (gamma rays and neutrons) emitted by the fireball and the cloud in the first minute after detonation. Most of it is emitted in the first few seconds.   |
| Intensity:                | See "Radiation Intensity".   |
| Ionizing Radiation:       | See "Nuclear Radiation".   |
| Kiloton (KT):             | A unit of measure of nuclear weapon yield; equivalent to the explosive energy of 1000 tons of TNT. Used in reference to low-yield weapons.   |
| Late Effects (Radiation): | Medical effects noticeable months to years after receiving a radiation dose; for example, leukemia, cancer, anemia, and general shortening   |

of the life span (as distinguished from "Early Effects").

**Latent Period:**

The period of time between exposure to radiation and the onset of medical effects. In general, the larger the dose, the sooner the injury becomes noticeable.

**Limited Protection:**

A zone within a consolidated protection system that provides protection against liquid and solid CBR agents but not gaseous agents.

**Line Source:**

A configuration of chemical or biological agent disseminated from a continuously moving munition or device.

**Liquid Dosage:**

See "Dosage (Dose), Chemical and Biological".

**List:**

A definite attitude of transverse inclination of the ship of a permanent nature.

**Mark V Protective Mask:**

Standard Navy shipboard protective mask.

**Mask-only:**

A "mask-only" environment provides personnel some relief from MOPP gear; personnel must be inside the ship where danger of transfer hazards are minimal; "mask-only" can tolerate exposure to vapor hazards but not transfer hazards.

**Material Condition:**

The material condition of readiness refers to the degree of access and systems closure effected to limit the extent of damage to a ship. There are three material conditions of readiness: Condition X-Ray, Condition Yoke, and Condition Zebra.

**Megaton (MT):**

A unit of measurement of nuclear weapon yield equivalent to the explosive energy of 1 million tons of TNT; used in reference to high-yield weapons.

**MB Detector Paper:**

See "Detector Paper".

**Microbe:**

A microorganism.

**Micron:**

A unit of length equal to one millionth of a meter, or one thousandth of a millimeter; denoted by the Greek letter mu ( $\mu$ ).

|                    |  |
|--------------------|--|
| Microorganisms:    | <p>Minute, living organisms too small to be seen with the unaided eye. On the basis of structural and behavioral characteristics, microorganisms may be grouped, in order of decreasing size, as follows: fungi, protozoa, bacteria, rickettsiae, and viruses.</p> <p>Only a small percentage of microorganisms are capable of producing disease in man, plants, or animals. These are called pathogens.</p> |
| MK III Suit:       | <p>British-made chemical protective overgarment still used aboard some USN ships. The U.S. version of the suit is called "CPO" for Chemical Protective Overgarment.</p>  |
| M9 Detector Paper: | <p>See "Detector Paper".</p>   |
| Monitoring:        | <p>The continued or periodic act of seeking to determine whether CBR contamination is present.</p>   |
| MOPP:              | <p>The acronym for Mission-Oriented Protective Posture; a flexible system for establishing shipboard readiness levels through the use of various elements of collective and individual protection consistent with the threat, work rates imposed by the mission, and environmental conditions.</p>   |
| MOPP Gear:         | <p>The combination of all individual protective equipment including suit, boots, gloves, mask, medical items, and decontamination kits.</p>  |
| M256 Detector Kit: | <p>A detector kit which provides positive identification of chemical agents; detects blood, blister, lewisite, and nerve agents.</p>   |
| Myosis:            | <p>Excessive contraction of the pupils of the eyes caused by exposure to minute quantities of nerve agents; the pupil is unable to dilate and remains contracted, and task performance is severely impaired or impossible; often accompanied by pain and a headache.</p>   |
| Nerve Agent:       | <p>A lethal chemical agent which interferes with the transmission of nerve impulses; absorbed into the body through the eye, respiratory tract or the skin; affects the nervous and respiratory systems and other vital body functions.</p>  |

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| <b>Neutron Radiation:</b>          | Uncharged subatomic particles produced by nuclear reactions such as fission and fusion; a major component of "Initial Radiation".  |
| <b>Nominal Nuclear Weapon:</b>     | A nuclear weapon whose yield is approximately 20 kilotons.   |
| <b>Non-persistent Agent:</b>       | A chemical agent that when released dissipates and/or loses its ability to cause casualties after about 10 to 15 minutes.  |
| <b>Non-Radive Area:</b>            | An area of the ship that is not in a radiation field.  |
| <b>Nuclear Radiation:</b>          | <p>Also called "Ionizing Radiation", nuclear radiation refers to:</p> <ol style="list-style-type: none"><li>(1) radiation (mainly gamma and neutron) produced directly by fission and fusion processes at the moment of a nuclear detonation (see "Initial Radiation"); and</li><li>(2) radiation emitted from the nuclei of the radioactive atoms in the contaminants (see "Transit Radiation" and "Deposit Radiation").</li></ol> <p>Nuclear radiations can be classified as corpuscular radiations (neutron, alpha and beta particles) and electromagnetic radiations (gamma rays).</p> |
| <b>OBA:</b>                        | Oxygen Breathing Apparatus   |
| <b>Operational Recovery Phase:</b> | The phase of operations that immediately follows the emergency phase; the objective is the recovery of the essential functions of the ship; see "Radiological Involvement".  |
| <b>Pathogen:</b>                   | Those microorganisms which are capable of producing disease (most microorganisms are non-pathogenic).  |
| <b>Penetration Dose:</b>           | See "Dose, Radiation".   |
| <b>Percutaneous:</b>               | Through the skin, leaving no externally visible sign of passage.   |
| <b>Percutaneous Hazard:</b>        | Produces hazardous effect through the skin.  |

- Permeable:** Having pores or small openings that allow passage of liquids or gases (Include reference to suits).
- Persistency:** An expression of the duration of effectiveness of a chemical agent; dependent on physical and chemical properties of the agent, weather, methods of dissemination, and shipboard environmental conditions; "persistent" and "non-persistent" should not be used to denote classes of chemical agents.
- Pre-wetting:** Activation of the Water Washdown System prior to the arrival of chemical, biological, or radiological contamination.
- r:** See "Roentgen".
- Rad:** A unit of absorbed dose of radiation. Useful in relating radiation dose to biological effects. The rad is a measure of the energy of any type of nuclear radiation absorbed per unit mass of irradiated material (in this manual, human tissue). Represents the absorption of 100 ergs of nuclear radiation per gram of the absorbing material or tissue. The rate of absorption is given in rad/hr or mrad/hr.
- RADIAC:** An acronym derived from "radioactivity, detection, indication, computation"; used as an all-encompassing term to designate various types of radiological measuring instruments or equipment.
- Shipboard radiacs issued for nuclear warfare operations and defense actions provide the radiation intensity and dose information needed for command decisions and for the control of personnel exposure.
- There are two basic types of radiacs used aboard ship: intensity (or dose-rate) meters, which indicate radiation intensity in terms of dose per unit of time; and dosimeters, which indicate the total dose received from radiation exposure; some radiac instruments provide both dose-rate and total dose information.
- Radiation:** See "Nuclear Radiation".

**Radiation  
Absorption:**

A process whereby some or all of the energy of radiation is transferred to the substance on which it is incident, or which it traverses. The medical effects (injury to skin) of skin dose of non-penetrating (beta and low-energy gamma) radiation.

**Radiation Burns:****Radiation Field:**

The area surrounding a contaminated location in which the air is permeated by gamma radiation emitted by the contaminants. The intensity (or strength) of a radiation field at a given location is measured in roentgens per hour (r/hr).

As the fallout material approaches the ship, the entire radiation field is due to airborne contaminants. As the fallout process continues and the ship becomes contaminated, part of the radiation field is from airborne radiation and part from deposit radiation. After fallout has ceased, the entire radiation field is from deposit radiation. There may be a small contribution to the radiation field from material in the water surrounding the ship.

Once all the fallout is deposited, the radiation field intensity decreases with time.

**Radiation  
Intensity:**

The rate at which radiation energy is absorbed at a point in the radiation field. In this manual, intensity is considered synonymous with "Dose Rate" and is measured in r/hr or rads/hr.

"Standard Intensity" is the intensity, or dose rate, at a standard reference time, usually taken as 1 hour after burst. If the fallout process has not ceased by 1 hour after burst, the standard intensity is defined as the intensity that would have existed at 1 hour after burst, had all the fallout material been deposited by that time.

(Note: Other documents use "Intensity" interchangeably with "Dose", and express it in rads).

**Radiation Sick-  
ness:**

The early effects resulting from a large penetration dose to all or a large part of the body. The first effects may become noticeable

in hours or days, depending on the dose. Radiation sickness is not a communicable disease, and does not cause the exposed person to be radioactive.

**Radioactive  
Contamination:**

See "Nuclear Radiation".

**Radioactive  
Particles:**

Soil particles or water droplets containing radioactive elements. This term should not be confused with alpha and beta radiations which are sometimes called particles.

**Radiological  
Countermeasures:**

Those actions undertaken to protect personnel from initial and residual nuclear radiation; intended to prevent an adverse effect on the ship's operational capability by forestalling casualties from radiation sickness among ship's personnel.

**Radiological  
Involvement:**

A term used to describe the situation a ship is in following a nuclear detonation; three degrees of radiological involvement have been defined in terms of the nuclear radiation factors of intensity, duration, and dose.

"Major Radiological Involvement" defines those situations in which nuclear radiation reaches a sufficiently high level (intensity) and remains there for a sufficient time (duration) to result in doses that will produce casualties in a relatively short time; the intensity level outside poorly shielded stations would produce roughly 300 to 1000 or more rads at the station in a relatively short time.

"Intermediate Radiological Involvement" defines those situations in which nuclear radiation intensities and durations do not threaten personnel survival but would result in substantial doses; these doses would be, very roughly, in the 200 to 300 rad range.

"Minor Radiological Involvement" defines those situations in which nuclear radiation intensities are low and will not result in doses of tactical significance; the main problem is the long-term hazard to personnel health from residual radiation.



For the purpose of shipboard nuclear warfare defense the three degrees of Radiological Involvement are related to the three major time phases of a nuclear detonation (Emergency, Operational Recovery, and Final Recovery) to define functional objectives and counter-measures.

Only a Major Radiological Involvement has all three phases; an Intermediate Radiological Involvement is considered to have only Operational Recovery and Final Recovery phases; a Minor Radiological Involvement has only a Final Recovery phase.

**Radive Area:**

An area in a radiation field.

**Rate of Change:**

Rate of change of air in a ship's compartment; usually expressed in minutes per change; see air change.

**Rem:**

A unit of biological dose of radiation equal to the number of rads absorbed, multiplied by the RBE (Relative Biological Effectiveness) of the given radiation (for a specified biological effect).

**Residual  
Contamination:**

Contamination that remains after steps have been taken to remove it or allowing it to decay normally.

**Rickettsiae:**

Intracellular, parasitic microorganisms that are intermediate in size between bacteria and viruses. Rickettsiae are from 0.3 to 0.5 micron in length and about 0.3 micron in diameter.

The rickettsiae are less prevalent and produce fewer diseases than bacteria and viruses; nevertheless, they cause important diseases such as Q fever, typhus fever, and the spotted fevers.

Rickettsiae are potential biological warfare agents. However, since they live only as parasites, they are more difficult to produce in quantity than bacteria because they require living cells for growth. Also, they are normally dependent on arthropod vectors for transmission, and are easily killed by heat, dehydration, or disinfectants. They are usually capable of being

removed by bacterial filters. They are not spore-forming.

**Roentgen (r):**

A unit of exposure dose of gamma (or X) radiation. Essentially a measure of the energy absorbed by a unit mass of air through which the radiation passes. The intensity (or strength) of a radiation field at a given location is measured in roentgens per hour (r/hr).

**Safe Stay Time:**

The time personnel may remain in the vicinity of a radioactive hot-spot without exceeding their Maximum Permissible Exposure (MPE).

**Shielding:**

A form of protection of shipboard personnel from ionizing radiation; results from the decrease in radiation (absorption) as it passes through water and ship structure; shipboard shielding stations are categorized as deep shelter stations and ready shelter stations .

Deep shelter stations are low in the ship and near the centerline; they provide maximum shielding, but often require that personnel be far removed from their battle stations.

Ready shelter stations are just inside the weather envelope with direct access to deep shelter; they provide minimum shielding but allow the crew to remain close to their battle stations.

**Shielding Factors:**

See "Transmission Factors:

**Standard Intensity:**

See "Radiation Intensity".

**Surface Burst:**

A nuclear detonation on the surface of the water (or ground), or near the surface so that the fireball touches the surface.

**Surface Zero:**

See "Ground Zero".

**Survey:**

The direct effort to determine the location and nature of the chemical agent on or in a ship.

**TAP Suit:**

Toxicological agent protective suit; an impermeable C/B suit used by EOD.

**Total Protection:**

A zone within a consolidated protection system that provides protection against liquid, solid, and gaseous CBR agents.

**Toxicity:**

The property possessed by a material which can cause injury to the physiological mechanism of an organism by chemical means, with the maximum effect being incapacitation or death.

**Toxins:**

Poisonous products of animal or vegetable cells which, when inhaled, swallowed or injected into man or animals, will cause illness or death. Botulin is an example. Toxins in the environment act much like chemical agents and they produce effects similar to those caused by chemical agents. Unlike microorganisms, some toxins can penetrate unbroken skin and they can be mixed with chemicals that can speed their penetration.

The US classifies toxins as biological agents; the Soviets and their allies view them as chemical agents, since it is possible to produce various toxins synthetically in the laboratory.

**Transit Radiation:**

Gamma radiation that is directly received from the radioactive cloud or base surge as they pass in the distance.

**Transmission Factors:**

In general, a factor used to express the reduction of radiation as it passes through a given material or combination of materials; in shipboard application, transmission factors refer to the ratios of radiation intensity at an interior location to that 3 feet above the weather deck above that location; transmission factors are the reciprocal of "shielding factors".

Because they are dependent on a number of variables, including the directionality of initial nuclear radiation, they are difficult to estimate and of limited use aboard ship.

**Triage:**

(NATO) The evaluation and classification of casualties for the purpose of treatment and evacuation. It consists of the immediate sorting of patients according to type and serious injury, and likelihood of survival, and the establishment of priority for treatment and evacuation to assure medical care of the greatest benefit to the largest number.

|                        |  |
|------------------------|--|
| Trichothecenes:        | Naturally occurring toxins produced by the chemical and physical processes going on in a living organism.  |
| V-agent:               | A type of nerve agent.   |
| Vapor:                 | Gas phase of a substance.  |
| Vaporization:          | To pass into the gas or vapor state; a phase change menopause.   |
| Vesicant:              | A blister-producing chemical, such as HD.  |
| Viruses:               | A group of parasitic microorganisms that live in the cells of their selected hosts. Viruses are so small (about 0.01 to 0.27 micron across their greatest dimension) they will pass filters which stop bacteria and rickettsiae. About 60 percent of all infectious diseases are caused by viruses. Viruses are potential biological warfare agents. |
| Water Washdown System: | A dry-pipe sprinkler system equipped with nozzles designed and arranged topside to throw a large water spray pattern on weather surfaces; water is supplied from the ship's firemain; originally designed as a countermeasure system for nuclear fallout, it is also effective in the control of chemical and biological contamination.              |
| Weathering:            | The process by which a chemical agent is removed from the ship's surface areas by the natural action of wind and waves.  |
| Wet-weather Clothing:  | Standard Navy garments designed for complete protection from rain and spray; adapted for protection of CBR Protective Suit; Class X clothing.  |